

Vol. XXI

No. 7

# DISSERTATION ABSTRACTS

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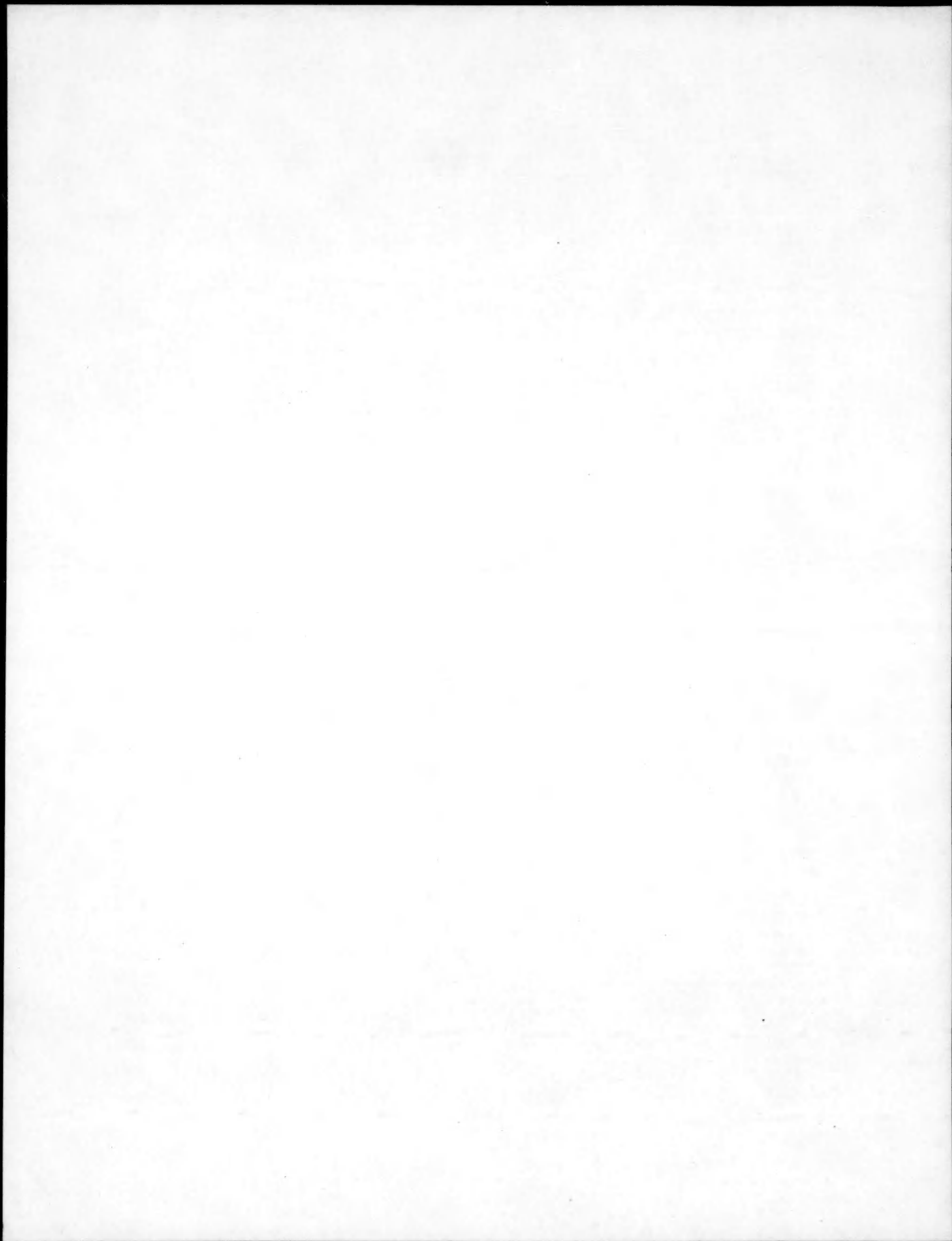
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## AGRICULTURE

### AGRICULTURE, GENERAL

#### COMPARATIVE VALUE OF CALCIUM METAPHOSPHATE AND SUPERPHOSPHATE FOR PLANT GROWTH ON DIFFERENT SOILS

(L. C. Card No. Mic 60-5871)

Raymond Richard Allmaras, Ph.D.  
Iowa State University of Science and Technology, 1960

Supervisor: C. A. Black

The ratio of the availability coefficient of phosphorus from calcium metaphosphate (CMP) to that from concentrated superphosphate (CSP) was obtained from measurements of plant response on 11 soils in the greenhouse. Availability-coefficient ratios ranged from 0.61 to 1.25 and were lower for calcareous soils than for acid soils.

Various laboratory measurements on mixtures of fertilizer and soil were made in an attempt to estimate the availability-coefficient ratios. The extent of movement of phosphorus from CMP particles into the surrounding soil during different lengths of time gave poor estimation of availability-coefficient ratios. Good estimation of availability-coefficient ratios was provided by the ratio of water-extractable orthophosphate from CMP to that from CSP after 24 days' incubation in soil except in two soils. These two soils contained a quantity of indigenous orthophosphate labile to  $P^{32}O_4^{=}$  which was readily rendered soluble by interaction of condensed phosphate from CMP with the soil. The best estimates of availability-coefficient ratios ( $r^2 = 0.77$ ) were provided by the ratio of the apparent orthophosphate from CMP to that from CSP after 24 days' incubation in soil. These values were obtained by an isotopic dilution of  $P^{32}O_4^{=}$  in the presence of  $(CH_3)_N$ -resin to hasten equilibration and to minimize hydrolysis of the condensed phosphate. Observed values were adjusted by means of a calibration curve obtained from similar incubation of soils with known quantities of  $KH_2PO_4$ . These findings indicated that variation in availability-coefficient ratios among soils resulted mainly from differences in hydrolysis of condensed phosphate of CMP to orthophosphate.

From a similar method of isotopic dilution and calibration with  $KH_2PO_4$ , the apparent rate of orthophosphate formation from condensed phosphate was much accelerated in the presence of soil and accelerated more where the condensed phosphate was added in solution than where it was added as the solid particles employed above. The rate of hydrolysis of condensed phosphate added in solution was greater in alkaline soils than in acid soils, whereas the reverse was found with phosphate added as solid particles. The cause of the opposing association of pH with hydrolysis of condensed phosphate added in solid particles of CMP or in solution was not investigated. From the known value of finely divided calcium carbonate as a conditioner for CMP, however, it may be suggested that rapid hydrolysis at

interfaces between the advancing condensed phosphate and soil, followed immediately by formation of a protective layer of a sparingly soluble calcium phosphate, was responsible. This mechanism could account also for the observed tendency for the rate of migration of phosphorus from CMP particles to decrease with increasing soil pH.

Microfilm \$2.50; Xerox \$7.20. 152 pages.

#### SOME EFFECTS OF NITRATES IN FORAGE ON RUMINANT ANIMALS

(L. C. Card No. Mic 60-6459)

Robert Field Crawford, Ph.D.  
Cornell University, 1960

Major Professor: Dr. W. K. Kennedy

The poisoning of cattle from nitrate in forage has been recognized for at least 65 years. The level of nitrate in forage that would kill half of the cattle (lethal level  $LD_{50}$ ) was reported to be about 15 gm. of  $NO_3$  per cwt. of animal.<sup>1</sup> This level was established by administering doses of  $KNO_3$  to nine calves with a stomach tube. From these data it was calculated that about 0.9 percent  $NO_3$  of the dry matter of forage was equal to the  $LD_{50}$  level. This was the only attempt that has been made to estimate the lethal levels of nitrate in forage for cattle and this level has been widely accepted by other workers.

In recent years exceptions to the previously estimated lethal levels of nitrate in forage and numerous reports of animal production losses (i.e., abortion, loss in milk production, loss in weight) that were attributed to sublethal levels of nitrate in forage have been reported. The objectives of this study were therefore to investigate the validity of the previously estimated lethal level of nitrate in forage for cattle, and to investigate the possibility of adverse sublethal effects of nitrate in forage.

Feeding trials with yearling dairy heifers indicated that a water solution of nitrate salts added to forage could be used as a tool to simulate nitrate in forage. Using this technique it was concluded that the lethal level  $LD_{50}$  for nitrate in forage was at least three times the presently accepted level. This conclusion was based on the degree of methemoglobinemia attained in 20 yearling dairy heifers on a ration of hay alone with increasing levels of nitrate. Death was prevented at higher levels of nitrate by administering an antidote of methylene blue when needed. The same group of animals was later given several levels of nitrate by a drench, and the results were comparable to the presently accepted  $LD_{50}$  established by administering nitrate with a stomach tube. It was concluded that the speed of intake of nitrate by the two techniques caused the difference in results.

The degree of methemoglobinemia in dairy cattle from



nitrate in forage was affected by the concentration of nitrate in the forage, the total quantity of nitrate consumed, and the speed of intake of the forage. It was also found that the level of methemoglobin was less when high levels of concentrate were fed supplementary to the forage containing nitrate salts.

It was further concluded that the reports in the literature that dealt with the lethal and sublethal levels of nitrate in forage for cattle were in error due to a lack of appreciation of the factors influencing nitrate toxicity. The basic error could be ascribed to the underlying assumption involved in all such experiments. The assumption was that the degree of toxicity from a dose of nitrate administered rapidly (i.e., by stomach tube, by a drench, by a capsule, in grain, or in milk) was equal to the degree of toxicity from an equal quantity of nitrate consumed over a period of hours as forage (i.e., hay, pasture, or silage) at the speed with which the animal could eat. Such an assumption was shown to be in error by experimental feeding trials.

Short term feeding trials with dairy cattle demonstrated that sublethal effects such as a loss in body weight, loss in milk production and abortion did not occur when oat hay containing nitrate well above the levels that were currently reported to cause such sublethal effects was fed. Further long term feeding trials should be conducted to establish the levels of nitrate in forage that will cause adverse sublethal effects.

1. Bradley, W. B., Eppson, H. F., and Beath, O. A., Livestock poisoning by oat hay and other plants containing nitrate, Wyo. Agr. Expt. Sta. Bull. 241, 1940.

Microfilm \$2.50; Xerox \$7.60. 164 pages.

#### SEASONAL VARIATION IN ACTIVITY OF NATURALLY OCCURRING GROWTH REGULATORS IN BROMEGRASS (BROMUS INERMIS LEYSS)

(L. C. Card No. Mic 60-6104)

Jerry Dean Eastin, Ph.D.  
Purdue University, 1960

Major Professors: M. R. Teel and R. G. Langston

The expression of apical dominance in varieties of brome grass adapted to the north central area of the United States presents pasture management problems that require careful attention in a successful forage production program. The purpose of this study was to investigate similarities and dissimilarities in the initial spring growth and in the regrowth of six brome grass varieties in 1958 (Experiment I). Based on these findings the seasonal fluctuations in growth regulator activity in a single variety were investigated in 1959 (Experiment II).

In Experiment I, using six varieties, four initial spring harvests were taken at successive weekly intervals. A fifth harvest was taken three weeks after the fourth harvest. The harvests ranged from early jointing (May 8) to the time panicles were turning brown (June 18). The regrowth was harvested in the jointing stage 47 days after the initial harvest of each respective plot.

Data collected indicated that during the growth phase

covered by the five initial spring harvests all varieties were quite similar with respect to quantitative measurements on yields, fructose content, and tiller number per plot. Tiller weights among varieties appeared to vary only slightly. There was no evidence that tiller number varied among harvests while tiller weights and yields increased with successive harvests.

In sharp contrast to the initial harvests varieties diverged with respect to yields, fructose content, and tiller weights in the regrowth harvests. Tiller numbers among varieties and among harvests appeared not to vary in the regrowth harvests. Harvests x variety interactions for yields and fructose content were also significant. In general, varieties which appeared to be similar during the initial growth phase appeared quite divergent with respect to each other during the regrowth phase except in the number of tillers per plot.

Since tiller number did not vary significantly among varieties, differential yields were a function of differential tiller weights. Apical dominance apparently limited the number of tillers that developed. It appeared that the expression of apical dominance was not due to competition for nutrients (sugars) between advanced and potential tillers since higher yielding varieties utilized their apparent superior assimilatory capacity for the increase of tiller weights rather than tiller numbers.

In Experiment II an attempt was made to characterize auxin activities, by the Avena straight-growth test, in crown (basal internodes and rhizomes) tissue during nine harvests of initial spring growth from April 25 (early jointing) to June 28. Harvests were taken at eight-day intervals. Fructose analyses were run on basal stubble and crown tissue. At early jointing the fructose content of the stubble was relatively high yet basal bud growth was suppressed. High auxin levels in crown tissue at this stage appeared to be associated with the suppression of bud growth. Auxin activities appeared to decline abruptly preceding anthesis and to rise again coincident with accumulation of fructose during which time elongation of basal buds preceded slowly. Under favorable moisture conditions basal buds developed into tillers without removing tops of the plants, indicating termination of apical dominance after anthesis.

Microfilm \$2.50; Xerox \$4.60. 87 pages.

#### EFFECT OF NUTRITION ON CARCASS LEANNESS IN SWINE

(L. C. Card No. Mic 60-5878)

James Riley Foster, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisors: Damon V. Catron and Virgil W. Hays

Four experiments involving 292 pigs were conducted to study the effect of 3-nitro-4-hydroxyphenylarsonic acid (3-N-4-HPAA) on carcass leanness. In each of these experiments at least one of the measurements used for evaluating carcass leanness (live probe, carcass backfat or percent lean cuts) suggested that 3-N-4-HPAA increased carcass leanness.

There was no significant treatment effect on percent

lean cuts in the three experiments in which the lean cuts were weighed. However, in one experiment in which 47 pigs from the control ration and 54 pigs from the 3-N-4-HPAA ration were slaughtered, the pigs fed 3-N-4-HPAA yielded a slightly higher percent of lean cuts than the control pigs.

In one experiment there was a significant 3-N-4-HPAA x protein level interaction on carcass backfat as the addition of the arsenical to the "high" protein ration resulted in a decrease in carcass backfat. Dressing percent was significantly higher when 3-N-4-HPAA was added to the ration in this trial. In this experiment the feeding of the "high" protein ration resulted in a highly significant improvement in carcass leanness in all four measurements used - live probe at both 130 and 200 pounds body weight, carcass backfat measured at the packing plant and percent lean cuts.

In two experiments involving 144 pigs the feeding of cod liver oil failed to increase carcass leanness. There was very little difference between treatments with respect to rate of gain; however, feed efficiency was improved when cod liver oil was included in the ration. In one experiment in which cod liver oil was fractionated into the saponifiable and nonsaponifiable fractions, there was an increase in percent lean cuts when the saponifiable fraction was fed.

Three experiments involving 224 pigs were conducted to evaluate the effect of styramate, a muscle relaxant, on carcass leanness. In one experiment the addition of styramate to the ration resulted in significantly faster gains and a significant improvement in feed efficiency. In this experiment live probes taken at 110 and 200 pounds body weight indicated the styramate-fed pigs were leaner. In this experiment the pigs fed styramate yielded a significantly higher percent of lean cuts than the control pigs. In two subsequent experiments styramate failed to affect carcass leanness significantly. There was an indication in the two latter experiments that the response to styramate was associated with sex. The gilts fed styramate were slightly leaner than the controls, whereas, the barrows fed styramate were fatter than the controls as measured by carcass backfat and percent lean cuts.

Microfilm \$2.50; Xerox \$6.60. 136 pages.

#### CHARACTERISTICS OF FARM PRACTICES ASSOCIATED WITH RATE OF ADOPTION

(L. C. Card No. Mic 60-5444)

Joseph Edward Kivlin, Ph.D.  
The Pennsylvania State University, 1960

The purposes of this study were (1) to develop a comprehensive set of characteristics by which a wide variety of farm practices could be compared and (2) to investigate the association of these characteristics with rate of adoption to determine whether practices which are adopted at the same rate possess similar characteristics. If such is the case, prediction of rate of adoption of new practices would be facilitated.

Data were obtained in 1959 from agricultural leaders and commercial dairy farmers in selected portions of Susquehanna County, Pennsylvania.

To isolate the effects of differences among farm practices on the rate at which they were adopted, the sample of farmers was restricted on the basis of tenure, age, size of farming operations, formal education, and social participation. Previous research findings have indicated a generally consistent relationship between these factors and adoption. Off-farm work, type of dairy enterprise, type of farming area, and the effect of Extension media were also partly controlled to ensure applicability of practices and to add further to the homogeneity of the sample. The sample was also restricted to respondents who had started farming prior to 1952. Respondents were asked which of the listed farm practices they had adopted and when they first began to use them. From these data, comparative rates of adoption - the average percentage adoption per year for the eight year period of most rapid adoption - were calculated for 43 practices. Rate of adoption rather than per cent of total adoption was used as the dependent variable to equalize opportunity for adoption among practices and to stress quickness of adoption.

Information was also obtained from a panel of 20 agricultural leaders who were familiar with farming conditions and practices in the sample area. This panel of judges ranked 43 practices on the degree of possession of 11 characteristics which were believed to be associated with rate of adoption. Judges' opinions, rather than sample farmers' opinions, were used because it was believed that farmers' perceptions of practices would likely be biased by their own acceptance or rejection of the practices. The characteristics which were used were initial cost, divisibility of trial, compatibility, complexity, continuing cost, recovery of cost, mechanical attraction, association with main enterprise (dairying), saving of time, saving of physical discomfort and advantage.

Correlation methods were used in analysis. There were significant ( $p$  less than .05) zero order correlations between rate of adoption and advantage ( $r = .40$ ), saving of time ( $r = .41$ ), and complexity ( $r = -.30$ ). Saving of physical discomfort and compatibility approached significance, while the other characteristics had low correlations.

Multiple correlation analysis disclosed that, combined, the 11 characteristics accounted for 51 per cent of the variability in rate of adoption. The variables most highly associated with rate of adoption were advantage, mechanical attraction, and complexity. A practice which will be adopted rapidly is likely to have much promise of financial and other advantage to the over-all farm program, including a saving of time. It is a practice which is easy to understand and use, and which exhibits considerable mechanical attraction.

Considerations of cost are probably negligible. Given the applicability of a practice, neither the initial cost, nor the continuing cost, nor the speed of recovery of cost are likely to influence rate of adoption one way or the other. Similarly, the degree to which a practice may be divisible for trial, the compatibility of a practice with the previous experience of the adopter, and the degree to which a practice may afford a saving of discomfort are not likely to have an appreciable effect on the rate of adoption.

Variables which were used need to be tested further by replication in other studies. New variables need to be included as others are eliminated or controlled. It is likely that new variables will prove to be specific components of the more "global" characteristics used in this study such as advantage, complexity, and compatibility.

Microfilm \$2.50; Xerox \$5.40. 107 pages.



STUDIES ON THE RELATIONSHIP  
BETWEEN SITOTROGA CEREALELLA Oliv.  
(ANGOUMOIS GRAIN MOTH), PLODIA  
INTERPUNCTELLA Hbn. (INDIAN MEAL  
MOTH) AND STORAGE FUNGI.

(L. C. Card No. Mic 60-5165)

Chandra Prakash Misra, Ph.D.  
University of Minnesota, 1960

Sitotroga cerealella Oliv. (Angoumois grain moth):-

The studies show a close biological relationship between the Angoumois grain moth and storage fungi especially of the Aspergillus glaucus group and Penicillium sp. The grain moths bring a slow but constant increase in mold count in the developing grain. Their frass contains nearly a billion viable spores of storage fungi per gram. Eggs carry the fungus spores only externally, all the other stages of the moth carry viable fungus spores inside and outside their bodies. Viable fungus spores are carried in abundance in the proventriculus and rectum of the adult moths. Larvae, pupae and adults free from storage fungi were developed on mold free wheat and were found to be smaller than those developing in moldy wheat. The fungi perhaps provide some nutrition to the developing moths. The odor of moldy wheat is more attractive to the grain moths. The moths prefer moldy wheat and develop faster in it than in clean wheat. Aspergillus ochraceus a storage fungus was found toxic or lethal to the grain moths, the confused flour beetle, the lesser grain borer, and the granary weevil, but less so to the rice weevil.

Plodia interpunctella Hbn. (Indian meal moth):-

A developing population of Indian meal moth is accompanied by only a relatively slow and relatively slight increase in the moisture content of the infested grain. Larvae inoculate the grain with storage fungi and carry more storage molds than any other stage. Penicillium and the Aspergillus glaucus group were found commonly associated with the Indian meal moth. The larvae carried viable fungus spores in their alimentary canal. Moldy grain did not materially affect the period of development, size and health of the moth; but larvae were reared on pure cultures of the Aspergillus glaucus group and Penicillium and passed through the complete cycle in the normal length of time. Such adults were found to be smaller and weaker than those raised on whole wheat grain. The frass of the Indian meal moth contains about 20 million viable fungus spores per gram, especially of the Aspergillus glaucus group and Penicillium sp. Aspergillus ochraceus also was found toxic or lethal to these moths.

Microfilm \$2.50; Xerox \$4.80. 92 pages.

CONTRIBUTION OF CARBONYL COMPOUNDS  
TO FLAVOR DETERIORATION IN  
DRY WHOLE MILK

(L. C. Card No. Mic 60-5452)

Owen W. Parks, Ph.D.  
The Pennsylvania State University, 1960

Objectional off-flavors develop in dry whole milk during manufacture and storage which hinder its utilization as an acceptable beverage product. This investigation attempted to identify some of the compounds present in stored dry whole milk and to determine their significance in the stale flavor.

The initial observations showed that carbonyl-type compounds contribute to the odor characteristics of the low temperature-reduced pressure distillate for reconstituted dry whole milk. Identification of the carbonyls as their 2,4-dinitrophenylhydrazones was attained by column and paper chromatography, ultraviolet spectroscopy and melting point determinations.

Formaldehyde, acetaldehyde, acetone, pentanone-2, hexanone-2, heptanone-2 and nonanone-2 were conclusively identified as constituents of the distillate from a relatively good dry whole milk. In addition to these carbonyls, evidence of cis and trans-furfural, butanone-2, undecanone-2, pentadecanone-2 and nonanal was obtained.

In contrast to the above, formaldehyde, acetaldehyde, acetone, benzaldehyde, butanone-2, pentanal, hexanal, heptanal, octanal, and nonanal were positively identified in the distillate of a deteriorated dry whole milk. Evidence that nonanone-2, undecanone-2, pentadecanone-2, decanal, dodecanal, two mono and two diunsaturated carbonyls were constituents of this product was obtained. In addition, the presence of numerous other carbonyl compounds was evident. Identification of these was hampered by decomposition and lack of adequate separation procedures for the 2,4-dinitrophenylhydrazones.

The results of relatively quantitative studies employing column and paper chromatography coupled with ultraviolet studies suggest that carbonyl-type compounds are significant in the stale flavor of dry whole milk. A comparison of the types and relative concentrations of these compounds with flavor criticisms of the products assigned by a taste panel indicates that either ketones or aldehydes, or mixtures of these, can impart a flavor characterized as the stale flavor. Furthermore, these studies showed that the descriptive terms used to characterize the flavors developing in stored dry whole milk are influenced by the relative concentrations of the carbonyls in the product. Threshold studies on varying concentrations of individual carbonyls as well as mixtures are needed before definite conclusions as to their precise role in the stale flavor can be determined.

Quantitative data on pasteurized, homogenized fresh milk showed that, with the exception of carbonyls up to and including four carbons in chain length, the compounds conclusively and tentatively identified in the various dry whole milk products during the course of this investigation are present as a result of heat processing and storage of the product.

Further results of this investigation indicate: (1) that hexanone-2 arises in stored dry whole milk as a result of a reaction or series of reactions different from that of the other methyl ketones and (2) the use of deodorized milk fat



in conjunction with nitrogen packing is worthy of investigation as a possible method of holding dry whole milk for prolonged periods of storage.

A method designed for determining the future storage life of dry whole milk is proposed on the basis of results of this investigation. The procedure encompasses the quantitative determination of hexanone-2 and hexanal in the product and referring these quantities to previously prepared standard curves relating their concentrations to degree of deterioration.

Microfilm \$2.50; Xerox \$4.00. 71 pages.

STUDIES OF THE BIOLOGY AND  
ECONOMIC IMPORTANCE OF THE  
TARNISHED PLANT BUG, *LYGUS*  
*LINEOLARIS* (P. DE B.), IN RELATION  
TO BIRDSFOOT TREFOIL  
SEED PRODUCTION.

(L. C. Card No. Mic 60-6467)

Richard Lee Ridgway, Ph.D.  
Cornell University, 1960

In view of the existing evidence pointing to the importance of the tarnished plant bug, *Lygus lineolaris* (P. de B.), as a pest of birdsfoot trefoil, *Lotus corniculatus* L., grown for seed, studies on the biology and economic importance of the tarnished plant bug as it is related to birdsfoot trefoil seed production were undertaken.

Studies on the seasonal history of the tarnished plant bug were conducted by making observations in the field, by making weekly collections of insects, and by dissecting females to study egg development. All of the information indicates that there are at least 2 and probably 3 generations each year of the tarnished plant bug associated with birdsfoot trefoil in New York.

Using green legumes of the common bean, *Phaseolus vulgaris* L., as a source of food and as an oviposition site, the tarnished plant bug was reared in the laboratory. The average lengths in days of the incubation periods of the egg stage at 15°, 20°, 25°, 30°, and 35° C. were 42.08, 14.66, 7.62, 6.65, and 6.04, respectively. The rate of development of each nymphal instar was determined at 20°, 25°, and 30° C. The mean lengths in days of all instars combined at these temperatures were 31.47, 1968, and 14.91, respectively. First instar nymphs failed to survive at 35° C. Preliminary investigations indicated a preoviposition period of 7 days at both 30° and 35° C. and slightly over 8 days at 25° C. Some observations on duration of the preoviposition period were also made at lower temperatures.

Preliminary investigations of the sex ratio revealed that, averaged over the growing season, the males of the tarnished plant bug outnumber the females. However, females significantly outnumbered males in groups of tarnished plant bugs collected from tanglefoot traps in the spring, prior to the appearance of the first new adults of the season.

An experiment designed to determine the height of flight of the tarnished plant bug showed that about 90 percent of these insects fly within 6 feet of the ground, and few, if any, fly higher than 18 feet.

Studies in which tarnished plant bugs were caged on birdsfoot trefoil plants indicate that this insect is capable of causing buds and terminals to blast. The tarnished plant bug is also capable of producing shriveled seed.

A method was developed whereby the seed yields in pounds per acre could be estimated by counting the number of legumes present in square foot areas.

In most instances, treatments with aldrin, parathion, DDT, and toxaphene significantly increased seed yields of birdsfoot trefoil when applied in mid-June to control the tarnished plant bug. In addition, a number of insecticides were evaluated for their effectiveness in controlling the tarnished plant bug. Dimethoate, Dibrom, Dylox, methyl-Trithion, and aldrin were the most effective.

Microfilm \$2.50; Xerox \$6.40. 135 pages.

NITROGEN IMMOBILIZATION AND  
DECOMPOSITION OF CROP RESIDUE  
IN SOIL AS AFFECTED BY  
RESIDUE PARTICLE SIZE

(L. C. Card No. Mic 60-4905)

John Leonidas Sims, Ph.D.  
Iowa State University of Science and Technology, 1960

Supervisor: Lloyd R. Frederick

The influence of particle size of crop residue on nitrogen immobilization and decomposition as measured by CO<sub>2</sub> evolution was studied. The laboratory incubations at 25° C of different particle size fractions of cornstalk pith and alfalfa root residues were carried out under conditions varied to include; (a) two Clarion sandy clay loam soils, one previously under continuous corn and one under meadow; (b) soil media with different amounts of residue or nitrate nitrogen; (c) sand media free of inorganic colloids. The particle size fractions of residue used ranged from < 0.25 mm to 19 mm in size.

Reduction in CO<sub>2</sub> evolution as great as 47% occurred when the particle size of pith or alfalfa residue was increased during incubations in both sand and soil. Size fractions of pith < 2.4 mm in diameter decomposed at nearly the same rate but a tendency for the < 0.25 mm fraction to decompose more slowly than the 0.25-2.38 mm fraction was noted in soil. The absence of this apparent reversal of particle size effect in sand indicated that soil colloids may have inhibited decomposition of the < 0.25 mm residue fraction.

CO<sub>2</sub>-carbon evolved was inversely related to the amount of nitrate N added as calcium nitrate for the range of N additions of 2.5 to 16 mg N per 100 g soil media. Reduction in CO<sub>2</sub> evolved ranged up to 25% when pith of < 0.25 mm was added. When pith of 19 mm size was added, little or no reduction occurred. Since reduction in decomposition also occurred with comparable additions of calcium chloride, the concentration of salt appeared to be the major cause of the reduction.

CO<sub>2</sub> evolution from pith was affected by the solid phase of the medium and decreased as follows: sand = > Clarion sandy clay loam from meadow > Clarion sandy clay loam from continuous corn. The amount of CO<sub>2</sub> evolved from

0.6 g pith was approximately double the amount evolved from 0.3 g pith, when adequate N was present.

The maximum amount of nitrate nitrogen immobilized decreased as particle size of cornstalk pith increased during incubation in both soil and sand. For incubations of pith in soil and at periods selected to be near maximum immobilization, (a) the amount of CO<sub>2</sub>-carbon evolved, and (b) the amount of nitrate N immobilized was linearly and inversely related to the square root of the mean diameter of pith particles; the ratio of CO<sub>2</sub>-carbon evolved to nitrate N immobilized was found to have a direct linear relationship to the square root of the mean diameter of pith particles.

The amount of nitrate N immobilized did not appear to change significantly when different amounts of calcium nitrate were added. Smaller amounts of nitrate N were immobilized and greater amounts of N were released when alfalfa root residue of 15 mm particle size was incubated in sand than when the same residue of < 0.25 mm or 2.38-4.76 mm particle size was incubated in sand.

The ratio of CO<sub>2</sub>-carbon evolved to nitrate N immobilized at incubation periods near maximum immobilization was used as a measure of the efficiency of N use in the decomposition. The efficiency of N used for the 19 mm fraction was about 3 times greater than for the < 0.25 mm fraction. This means more N would be available in the system for other uses, e.g. the growth of crops. The data presented indicated the greater efficiency for the 19 mm fraction was due to a deficiency of nitrate at the site of decomposition for this fraction.

Microfilm \$2.50; Xerox \$5.40. 108 pages.

#### EFFICIENCY OF LEGUME RESIDUE NITROGEN AND INORGANIC NITROGEN IN CORN PRODUCTION

(L. C. Card No. Mic 60-5892)

William Neil Sutherland, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: Dr. W. D. Shrader

An intensive study of an experiment where corn is grown continuously and in a corn, oats, meadow rotation was conducted. The experiment is located on the Southern Iowa Experimental Farm, an Edina silt loam, and was initiated in 1952. The soil is a Planosol formed from loess under grass on flat upland divides.

The objectives of this study were (a) to determine the amount of nitrogen furnished by a meadow crop in a corn, oats, meadow rotation, (b) to determine if the corn yield response to a meadow crop is due solely to the nitrogen furnished by the meadow, and (c) to evaluate the effect of the two cropping systems (continuous corn and a corn, oats, meadow rotation) on total carbon and nitrogen of the soil.

By measuring nitrate nitrogen of the soil in the spring and fall of 1957 and 1958, measuring residual nitrogen at the close of each season by laboratory and greenhouse procedures and by measuring total plant uptake of nitrogen, an estimate of nitrogen provided through the legume and through commercial fertilizer was derived. Estimates of the amount of nitrogen provided by the meadow crop ranged

from 123 to 200 pounds per acre in 1957 and from 54 to 83 pounds per acre in 1958. The estimates of the continuous corn treatments, where 30, 60, and 120 pounds of nitrogen were applied, were usually higher than the actual treatments. Where 240 pounds of nitrogen were applied to continuous corn, the estimates were usually lower.

In order to compare the efficiency of the two nitrogen sources, the average treatment yields were plotted against the estimated nitrogen supplied. By use of regression analysis and confidence limits about the regression line, the hypothesis that the benefit from the meadow crop was due solely to nitrogen, could not be rejected, except in one case. The exception occurred with one comparison of the 1957 data, the year in which the rotation corn had the advantage of 2 additional inches of available soil moisture.

Total carbon analysis of the 0- to 6-inch and 6- to 12-inch layers of soil showed that high rates of nitrogen applied to continuous corn had increased carbon levels over the amount contained in soils taken from the continuous corn check plots in 1953. Levels of carbon in the rotation corn plots in 1957 and 1958 were intermediate between those of the 1958 highly fertilized continuous corn and the 1953 continuous corn check plot levels.

A study of total nitrogen analysis of soils for the 0- to 2-foot layer resulted in conclusions similar to those for the total carbon analysis. The total nitrogen observations, where highly fertilized continuous corn was grown, were higher than those for the continuous corn check plot soils sampled in 1953 or 1958. The total nitrogen values for the rotation corn plots in 1957 and 1958 were again intermediate between the above comparisons.

Microfilm \$2.50; Xerox \$5.20. 103 pages.

#### THE TEMPERATURE DEPENDENCE OF THE DRYING OF HORIZONTAL SOIL COLUMNS

(L. C. Card No. Mic 60-4588)

Craig Loren Wiegand, Ph.D.

Utah State University, 1960

Major Professor: Dr. Sterling A. Taylor

Experiments were conducted to gain information on the rate limiting process or processes in the drying of soil. The temperature and moisture distributions were measured in soil columns dried by passing air through a 1 cm. air gap at one end of the columns. The experiments were carried out at temperatures ranging from 12.7° to 37.7° C using two sizes of soil columns. The Arrhenius equation was applied to the data in order to obtain the activation energies for the drying process from its temperature dependence. The activation energies were compared with those for various properties of pure water and with activation energies for evaporation, transpiration, and moisture flow calculable from the literature.

Not all experiments behaved the same with respect to the temperature distributions resulting from evaporative cooling, but the drying of all runs was expressible by the equation  $Q = a t^b$  wherein  $Q$  is the cumulative evaporation,  $t$  is time, and  $a$  and  $b$  are constants. The average value of  $b$  for all runs was 0.91 for about the first two days of drying. The slope then changed and the average value of



b for all runs was 0.47. The parameter a was a function of the equilibrium temperature. The values of b and other evidence indicate that the initial rate of evaporation was limited by external drying conditions. After the slope change moisture flow within the soil columns limited the rate of evaporation.

The activation energy calculated from the Arrhenius theory for the period of time up to the slope change was  $5.23 \pm 1.09$  kilocalories mole<sup>-1</sup> water for one set of experiments and  $7.24 \pm 1.38$  kilocalories mole<sup>-1</sup> water for another set of experiments. By comparison with activation energies available from data in the literature, activation energies of this magnitude appear to be characteristic of the drying of porous materials. A mechanism of flow which exhibits characteristics of both liquid and gaseous phase molecular processes is indicated.

The moisture distribution measured by the tensiometers could not be quantitatively related to the evaporation rate, but the tensiometer readings and direct gravimetric sampling revealed a parabolic distribution of the moisture with distance from the drying surface. This moisture distribution is apparently characteristic of the desaturation of soil. It has important implications in many unsaturated flow phenomena including moisture flow to roots and to wells, and fallowing. It also throws doubt on the rigor of assumed infinite and semi-infinite boundary conditions for sample thicknesses practical in laboratory experiments.

Microfilm \$3.80; Xerox \$13.30. 294 pages.

## AGRICULTURE, ANIMAL CULTURE

### THE RELATIVE SIGNIFICANCE OF FACTORS AFFECTING AND/OR ASSOCIATED WITH SLAUGHTER, CARCASS AND TENDERNESS CHARACTERISTICS OF BEEF.

(L. C. Card No. Mic 60-5127)

Richard Harvey Alsmeyer, Ph.D.  
The University of Florida, 1960

Consumer preference studies indicate that consumers are primarily interested in leanness and tenderness attributes of beef. The primary purpose of this study was to determine the relative significance of factors affecting and/or associated with beef tenderness.

Tenderness evaluation by taste panel and Warner-Bratzler shear methods and carcass characteristics of 538 cattle from four locations within the State of Florida provided the basic data for this study. Animals were of known breeding and represented the major beef breeds.

Breaking strength of metacarpal and metatarsal bones and hide thickness of 165 animals were studied to determine the relationship of these measurements with tenderness. Certain physical measurements of metacarpal and metatarsal bones of 100 cattle were studied to determine the relationship between bone characteristics and carcass meatiness.

Weights of items removed during the slaughter operation of 222 animals were evaluated to determine the effect of per cent of Brahman breeding on certain slaughter

characteristics. Carcass measurements of 125 beef carcasses were analyzed to determine the effect of per cent of Brahman breeding. The carcasses were broken into wholesale cuts to determine the relationship of per cent of Brahman breeding and yield of wholesale cuts.

Partial regression coefficients with animal age and percentage Brahman breeding constant indicated that marbling was related to panel tenderness but not to Warner-Bratzler shear values; outside finish was not related to tenderness. The effect of these two factors on tenderness was of low magnitude. Carcass conformation was related to tenderness through partial regression analysis with animal age and per cent of Brahman breeding constant, but again the relationship was small. It appeared that slaughter age was not even slightly related to tenderness and that altering age at slaughter within practical limits would have little effect on tenderness. Although carcass grade was significantly related to tenderness, partial regression of tenderness on carcass grade with animal age and percentage Brahman breeding constant indicated that carcass grade must be increased slightly over three full grades to increase the panel tenderness score from average to above average.

Breed of sire showed a significant effect on tenderness with age and location constant. Animals of more than 50 per cent Brahman breeding were less tender than animals of less than 25 per cent Brahman as evaluated by panel with age and grade constant. Tenderness was found to be highly heritable with estimates of 67.1 and 27.6 per cent for panel and shear, respectively, for the within breed intraclass correlation of offspring by the same sire.

The relative significance of factors affecting and/or associated with tenderness showed per cent of Brahman breeding the most important. Percentage Brahman breeding accounted for 12.05 per cent of panel tenderness variability while carcass grade explained 9.24; outside finish, 3.13; conformation, 2.55; marbling, 1.06 and slaughter age, 0.26 per cent of panel tenderness variability. Carcass grade accounted for 10.40 per cent of shear variation and percentage Brahman breeding explained 5.41; outside finish, 2.25; conformation, 0.47; marbling, 2.93 and animal age, only 0.29 per cent of the variability in Warner-Bratzler shear force.

Hide thickness showed only a slight relationship with tenderness; bone breaking strength was slightly related to tenderness. Measurements of metacarpal and metatarsal bones did not appear to be reliable indicators of muscling in the beef carcass when weight of carcass and per cent Brahman breeding were held constant.

When carcass grade and weight were held constant, animals with more than 75 per cent Brahman breeding had greater weights of hide, lengths of leg and lower weights of gastro-intestinal tract and contents, circumference of round, chuck thickness and weights of flank than animals with less than 25 per cent Brahman breeding. Animals with 75 per cent Brahman breeding had greater weights of feet and hide, lengths of leg and weights of round, but less marbling and chuck thickness than animals of less than 25 per cent Brahman breeding. Animals with 50 per cent Brahman breeding possessed greater weights of head, hide and feet and less chuck thickness than animals of less than 25 per cent Brahman breeding. Animals of 25 per cent Brahman breeding had greater weights of flank than animals of less than 25 per cent Brahman breeding.

Microfilm \$2.50; Xerox \$6.20. 127 pages.



**THE INFLUENCE OF CELLULOSE, CRUDE  
FIBER AND SUPPLEMENTAL ENERGY  
IN THE DIET OF CHICKS.**

(L. C. Card No. Mic 60-5413)

John Joseph Begin, Ph.D.  
The Pennsylvania State University, 1960

A series of five experiments were conducted to study the effects of cellulose, crude fiber from several sources and various fats and oils on chick performance. The criteria used to evaluate the various dietary supplements were: growth response, feed and nutrient utilization and the metabolizable energy value of the diet.

The use of isocaloric diets and a constant nutrient balance technique demonstrated that the addition of cellulose or such crude fiber materials as oat hulls, cottonseed hulls or soybean hulls had neither a growth depressing nor a growth stimulating effect when included in the diet of chicks. The results indicate that when these materials are added to the diet without supplemental energy they cause a depression in growth and feed utilization and an over-all decrease in the utilization of the diet. The supplementation of the fibrous diets with either fat or oil, to increase the energy content, did alleviate the depressing effect on growth and feed efficiency. It was not however, a biologically efficient process since the over-all utilization of the diet, as measured by either the digestion of cellulose free organic matter or the percentage of the gross energy that was metabolized, was not markedly improved by the addition of supplementary energy.

Digestibility data indicate that neither cellulose nor crude fiber was utilized by the chick. The digestibility coefficients for these components of the diet ranged from slightly negative to slightly positive values. Nitrogen retention and ether extract digestion were not influenced by the crude fiber or cellulose level of the diet.

The data suggest that the metabolizable energy requirement of chicks from hatching to the age of 7 weeks is approximately 3.12 Calories per gram of diet. The level of crude fiber in the diet was not as important as the energy level. When adequate energy was present, the chick could tolerate rather high levels of fiber in the diet.

The results of this study indicate that neither the bulk nor energy value of the diet was the major factor responsible for stimulating feed intake. Finely ground cellulose had no influence on feed intake and neither did finely ground oat hulls, however, cottonseed hulls or soybean hulls did stimulate an increase in feed consumption. It appears from the data that feed intake was stimulated by a complex of factors, including energy level, density of the diet and the physical texture of the ingredients.

Very close agreement was obtained between metabolizable energy values calculated from the analyses of ingredients and values determined using a bomb calorimeter. It should be pointed out however, that the accuracy of calculated values depends upon the use of ingredients of uniform composition and for which reliable digestibility coefficients are known.

There was found to be very little evidence to support the conclusion of other investigators that fat has any distinctive attributes other than its energy contribution. It is evident from these data that neither fat itself nor the kind of fat had any effect on growth when added to the diet in amounts that would not influence the caloric value of the

diet. All fats and oils studied were found to be equal in their ability to replace calories from carbohydrate.

Evidence is presented which indicates that the fats and oils studied possessed a marked difference in their caloric value and in their influence on nutrient utilization. Soybean oil was found to be better utilized and to have a higher metabolizable energy value than any of the other fats or oil.

The presence of an indigestible material in the diet of chicks was not found to consistently influence the weight of the digestive organs. Finely ground cellulose or finely ground oat hulls did not increase the weight of the intestinal tract, particularly the gizzard, while cottonseed hulls or soybean hulls did cause an increase in gizzard weight. It appears that the increase in size of the gizzard was due to a combination of feed intake and the physical texture of the ingredient employed as the source of fiber.

Microfilm \$2.50; Xerox \$8.00. 173 pages.

**THE PROLIFERATION OF LACTIC  
STREPTOCOCCUS BACTERIOPHAGE IN  
MILK CONTAINING CALCIUM-BINDING AGENTS**

(L. C. Card No. Mic 60-4181)

Vincent William Kadis, Ph.D.  
Purdue University, 1960

Major Professor: Dr. F. J. Babel

In the manufacture of various dairy products, particularly cheese and fermented milk preparations, lactic cultures are employed. It is very essential that the cultures ensure satisfactory acid production throughout the manufacturing processes. Failure of lactic cultures to develop sufficient amounts of acid results in very great financial loss to the dairy industry. One of the primary causes of slow acid production by lactic cultures is bacteriophage which lyses the lactic acid-producing bacteria. Research workers have not developed a culture which is resistant to all types of bacteriophage encountered in dairy plants.

It is well known that bacteriophages need calcium ions in their development. The use of media which will support the growth of the culture organisms, but in which the calcium is bound, or removed, is a relatively new approach to the bacteriophage problem in the dairy industry. The purpose of this study was to investigate the proliferation of lactic streptococcus bacteriophage in milk containing some calcium-binding agents, and to determine the effect of such agents on the growth of lactic streptococci. The compounds investigated were: mono- and disodium phosphate, mono- and dipotassium phosphate, ammonium oxalate, "sequestrenes" (di-, tri-, and tetrasodium ethylenediamine tetraacetate mono-, and dihydrates), and sodium and potassium tripolyphosphates.

Concentrated (60%) phosphate buffers were prepared from various mono- and dipotassium phosphates and mono- and disodium phosphates. By regulating the proportions of the phosphates, buffers were formulated which, after addition to milk at the rate of 2% salt concentration, resulted in the milk having pH values of 6.32 to 7.33.

The rate of growth and acid development by cultures of *Streptococcus lactis* and *Streptococcus cremoris* were determined in milk, with and without phosphate buffers added.

During the first 12 hours of an incubation period at 70°F., the test cultures developed more rapidly in plain milk than in any of the milk samples containing buffer 1 (36 g. monopotassium phosphate and 24 g. disodium phosphate per 100 ml.), 4 (40 g. dipotassium phosphate and 20 g. monosodium phosphate per 100 ml.) or 5 (48 g. dipotassium phosphate and 12 g. disodium phosphate per 100 ml.). However, after 24 hours, the bacterial counts of four of six test cultures grown in sterilized milk containing buffer 1, exceeded those of the control milk. Also, almost all of the test cultures had higher counts in milk containing buffer 4. The addition of buffer 5 to sterilized milk greatly retarded the growth of most test cultures. There was a relationship between bacterial growth and development of acid in milk containing buffers 1, 4 or 5.

The titers of six of the nine bacteriophage types tested were not decreased appreciably after four propagations in milk containing buffer 1 and host cells. Very similar results were obtained with milk containing buffer 4. In milk treated with buffer 5, the bacteriophage titers of filtrates were reduced to zero after two, three, or four transfers.

Investigations with milk containing 0.5% ammonium oxalate revealed that, during 24 hours of incubation at 70°F., slightly less acid was produced by all test cultures in this milk than in plain milk; a much firmer coagulum occurred in the milk containing oxalate. Six test cultures developed more acid when transferred to plain milk, after four successive propagations in milk containing 0.5% oxalate, than they did after four successive propagations in plain milk.

The bacteriophage titer of every test culture was reduced considerably, or completely, after the first, second, or third transfer in milk with 0.5% oxalate added.

Investigations with "sequestrenes," and sodium and potassium tripolyphosphates as calcium-binding agents, indicated that some of them were successful in preventing the development of bacteriophage in the presence of host cells, but they did not support normal growth of several test cultures.

The application of ammonium oxalate for suppression of bacteriophage in lactic cultures appears to have more merit than the use of potassium or sodium phosphates, or any other calcium-binding agents investigated in this study.

Microfilm \$2.50; Xerox \$5.80. 120 pages.

#### SIGNIFICANCE OF FEED PROTEIN FRACTIONS IN RUMINANT NUTRITION

(L. C. Card No. Mic 60-5886)

Charles Oran Little, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: Wise Burroughs

The special nutritional significance of soluble nitrogen, the merits of the water soluble fraction of soybean oil meal and the importance of readily available nitrogen and amino acid balance in ruminant rations were investigated.

Rate of ammonia production by rumen microorganisms from several feed proteins appeared to be more closely related to their nitrogen content soluble in rumen fluid than nitrogen soluble in dilute alkali or water. The influence of

a number of feed proteins on cellulose digestion in the artificial rumen was comparable to the extent of microbial attack of the proteins as measured by ammonia formation. Corn gluten meal and heat treated soybean oil meal (110°C for 24 hours) were particularly low in soluble nitrogen, only slowly converted to ammonia by rumen microbial degradation and ineffective as nitrogen sources for *in vitro* cellulose digestion by washed suspensions of rumen microorganisms. Regularly processed soybean oil meal, linseed meal, casein and purified soy protein were rapidly converted to ammonia and were effective sources of nitrogen for *in vitro* rumen cellulose digestion.

Lambs fed low quality roughage rations containing either regular or heated soybean oil meals at 7, 10, and 13 percent protein levels performed equally well. Both regular and heated soybean oil meals and linseed meal were similar in promoting growth when fed to lambs in semi-purified rations and were superior to corn gluten meal.

Corn gluten meal and soybean oil meal as protein sources in a semipurified ration were compared in a digestibility and nitrogen balance trial. Cellulose digested by lambs fed corn gluten meal was significantly lower than cellulose digested by lambs fed soybean oil meal. No apparent differences in protein digestibility and nitrogen balance were detected.

The water soluble fraction of soybean oil meal consistently improved cellulose digestion *in vitro* by rumen microorganisms. Lamb growth was favorably stimulated in three of four lamb trials in which the water soluble fraction of soybean oil meal was incorporated in a semipurified ration containing corn gluten meal as the major protein source.

Additions of lysine and methionine to corn gluten meal appeared to be of little value; however, the addition of urea to corn gluten meal markedly improved its value both in stimulating *in vitro* rumen cellulose digestion and in increasing lamb gains. The water soluble fraction of soybean oil meal was without effect on lamb performance when corn gluten meal and urea were combined as nitrogen sources in a semipurified ration.

It was concluded that quality of protein for ruminants is comprised of at least two separate identities, available nitrogen and unidentified factors. The quality factors are concentrated in the water soluble fraction, and readily available nitrogen is necessary for the utilization of the unidentified factors.

Microfilm \$2.50; Xerox \$5.80. 120 pages.

#### SOYA PROTEIN HYDROLYSATES AND SUPPLEMENTAL ENZYMES IN BABY PIG NUTRITION

(L. C. Card No. Mic 60-4903)

Lyle Homer Neagle, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisors: Damon V. Catron and Virgil W. Hays

Ten experiments involving 567 pigs were conducted to study the effects of supplementing corn-soybean oil meal rations with proteolytic enzymes of bacterial and fungal



origin and the predigestion of soybean protein on baby pig performance.

The addition of 0.25 percent pepsin (1:3000); 0.125 percent Pabst L-56-D; 0.25 percent Pabst L-276; 0.25, 0.50 and 1.0 percent Rhozyme B-6; and 0.25 and 0.50 percent Rhozyme P-11 to the ration improved pig gains, but not feed efficiency.

The addition of 0.125 percent Pabst L-56-D to corn-soybean oil meal rations containing 15 and 20 percent protein did not improve apparent digestibility of protein. Apparent digestibility of protein was significantly higher ( $P < 0.01$ ) in five-week-old pigs than in three-week-old pigs, and significantly higher ( $P < 0.01$ ) in the pigs fed 20 percent protein rations than in those fed 15 percent protein rations.

The feeding of soybean oil meal predigested for 3, 5 and 7 hours with 2.0 percent Protease 30 resulted in lowered pig gains and feed efficiency.

The feeding of soybean oil meal predigested with 2.0 percent pancreatin (N.F.) for 2, 6 and 9 hours at a pH of approximately 6.2 resulted in a decrease in pig gains. When hydrolysis was carried out at pH 7.8-8.2, the hydrolysates significantly lowered ( $P < 0.01$ ) pig gains and feed efficiency.

The feeding of soybean oil meal that had been hydrolyzed with 2.0 percent Pabst L-56-D for 1, 6 and 9 hours resulted in increased pig gains with each hydrolysate and a slight improvement in feed efficiency by feeding the nine-hour hydrolysate. Predigesting the soybean oil meal had very little, if any, effect on apparent digestibility of protein.

Predigestion of raw soy flour with 2.0 percent pancreatin (N.F.) for 0, 2, 4 and 6 hours significantly improved ( $P < 0.01$ ) pig gains and feed efficiency. Within the hydrolysates there was improved pig performance with increased destruction of the antitrypsin activity; however, feeding the hydrolysates, in which all of trypsin inhibitor activity had been destroyed, still resulted in poorer gains and feed efficiency than when soybean oil meal was fed.

Predigestion of raw soy flour with 2.0 percent Pabst L-56-D for nine hours significantly improved ( $P < 0.05$ ) gains, feed efficiency and apparent digestibility of protein in baby pigs. The antitrypsin activity was destroyed in the hydrolysate. The apparent digestibility of protein was slightly higher in pigs fed the raw soy hydrolysate ration than in pigs fed the soybean oil meal basal and the soybean oil meal hydrolysate rations, gains were lower and the feed required per pound of gain was higher in pigs fed the raw soy hydrolysate ration. These results demonstrate that trypsin inhibitor decreases apparent digestibility of soya protein, but that some other factor(s) instead of, or along with the antitryptic activity decreases the utilization of raw soya protein after it has been absorbed.

Microfilm \$2.50; Xerox \$6.60. 137 pages.

# GENETIC AND ENVIRONMENTAL INFLUENCES AFFECTING BIRTH WEIGHTS, WEANING DATA AND REPRODUCTIVE PERFORMANCE IN BEEF CATTLE.

(L. C. Card No. Mic 60-5144)

Walter Lamar Reynolds, Ph.D.  
The University of Florida, 1960

Factors affecting birth weight, weanling traits and reproductive performance of beef cattle at the Florida Range Cattle Experiment Station were analyzed. Constants were fitted for previous years' lactation status of the dam, month of birth, sex, pasture, age of dam, year and breed group. First order interactions were calculated and where interactions were important, the data were analyzed on a within-block basis.

Male calves were 3.7 pounds heavier at birth than females. Calves from nonlactating dams were 1.8 pounds heavier at birth than calves from lactating dams. Two, 3, 4, 11 to 12 and 13 to 18-year-old dams had calves that were lighter at birth by 5.5, 3.9, 2.2, 4.0 and 5.4 pounds respectively than calves from dams 5 to 10 years of age. Calves of predominately Brahman breeding were lighter at birth than calves containing little or no Brahman. Birth weights of crossbred and straightbred calves were similar with no evidence of hybrid vigor in this trait.

Weaning weights and slaughter grades of 2797 calves showed male calves to be 29.8 pounds heavier at weaning, but scored 0.14 slaughter grade lower than females. Calves from non-lactating dams were 6.4 pounds heavier and scored 0.1 of a grade higher than calves from lactating dams. January through April calves were heavier than May and December calves by 8.6 pounds and heavier than June through November calves by 15.4 pounds. Calves born to 2, 3, 4, 11 to 12, and 13 to 18-year-old dams were lighter by 63.5, 38.6, 17.8, 3.7 and 4.6 pounds respectively than calves from dams 5 to 10 years of age. Calves weaned from native pasture deviated from the mean by -43.5 pounds, those from the combination native-improved pastures by -12 to -8.8 pounds, while calves from improved pastures were 16 to 26 pounds heavier than the mean.

The constants for weaning weight of calves of various breed groups were: 5/8 Shorthorn-3/8 Brahman, +45.1; 3/4 Brahman-1/4 Shorthorn, +33.3; Shorthorn-Brahman  $F_1$ , +29.2; 3/4 Shorthorn-1/4 Brahman, +24.3; 3/4 Brahman-1/4 mixed, +22.3; British bulls x mixed cows, +19.2; 5/8 Brahman-3/8 mixed, +14.3; Shorthorn-Brahman crossbred bulls x cows of mixed breeding, +7.2; 7/8 Brahman-1/8 mixed, +8.3; 1/2 Brahman-1/2 mixed, -0.1; grade Brahman, -2.0; 7/8 Brahman-1/8 Shorthorn, -7.7; grade Shorthorn, -16.9; 7/8 Shorthorn-1/8 Brahman, -37.2; Brahman, -37.1; and purebred Shorthorn, -102.1. Calves of predominately Brahman breeding showed less response to improved pastures than crossbred and predominately Shorthorn calves.

In 3994 pasture matings, nonlactating cows exceeded lactating cows in calving percent by 25.8. Calving percentage for cows whose calves died was 17.7 lower the year following than that of open cows. The difference in weaning percent in native and improved pasture was 12.6 percent. Calving and weaning percentages reached a maximum at 7 years for age of dam. Constants for weaning percentage of the various age groups were -16.2, -11.6, -8.7, 3.1, 4.9, 12.1, 6.0, 7.9 and 2.6 for 2, 3, 4, 5, 6, 7, 8 to 10, 11 to 12



and 13 to 18-year old cows respectively. Calving rate in mature cows was higher in improved than in native pastures while in first exposure heifers the calving rate on native pastures was equal to or greater than that in improved pastures. Three and 4-year-old cows showed a greater disadvantage in reproductive efficiency in lactating than in nonlactating cows.

There was in general a higher survival rate from birth to weaning in breeding groups which showed hybrid vigor for growth rate. An exception occurred in the grade Shorthorn group which was above average weaning percentage but was below average in weaning weight. Weaning percent was increased by presence of hybrid vigor in the dam or in the calf among lactating cows, however, in nonlactating dams reproduction was similar in all groups.

Microfilm \$2.50; Xerox \$4.80. 92 pages.

**NITROGEN RETENTION AND NITROGENOUS URINE COMPONENTS OF GROWING COCKERELS AS INFLUENCED BY DIETHYLSTILBESTROL, METHYL TESTOSTERONE AND PORCINE GROWTH HORMONE.**

(L. C. Card No. Mic 60-5890)

Jerry Lee Sell, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: Dr. S. L. Balloun

Fifteen-milligram pellets of diethylstilbestrol (DES) were implanted in 6-week-old cockerels. During a 10-day period following treatment, DES increased weight gain more than 50 percent with no change in feed efficiency as compared to control chickens. DES had no immediate effect on percent of dietary nitrogen retained but from the 4th through the 10th day of treatment, there was a progressive decrease in the percent of dietary nitrogen retained by the DES-treated cockerels.

Although there was a large increase in the total nitrogen metabolized and a progressive decrease in percent nitrogen retention by the DES-treated cockerels, the percent of total urinary nitrogen excreted as uric acid, ammonia, urea, creatinine and creatine was not changed.

Six-week-old cockerels were each given intramuscular injections of 1.25 milligrams of methyl testosterone (MT) daily for 8 days. Weight gain was depressed 17 percent but efficiency of feed utilization was not affected by MT treatment. MT was ineffective for increasing the percent of dietary nitrogen retained by the cockerels. MT also had little effect on the distribution of the nitrogenous urine components, uric acid, ammonia, creatinine and creatine. The excretion of urea was increased both in quantity and as a percent of the total urinary nitrogen.

Six-week-old cockerels were each given intramuscular injections of 5 milligrams of porcine growth hormone (STH) preparation daily for 14 days. The effects of STH were studied during periods of fast and periods of ad libitum feeding. Weight gain was decreased by STH during periods when the cockerels had access to feed, but had little influence on weight gain during the 2-day periods following 48-hour fasts or on weight loss during fasting

periods. Nitrogen retention was not increased appreciably by STH during ad libitum feeding or during periods of recovery from fast. The STH preparation was also ineffective for decreasing nitrogen excretion during 48-hour fasting periods.

During ad libitum feeding periods, STH did not change the percent of urinary nitrogen excreted as uric acid, ammonia, creatinine and creatine. However, fasting decreased uric acid excretion and increased ammonia and creatine excretion; this alteration in urinary excretions was enhanced by STH. Urea excretion was increased by STH during both ad libitum feeding and fasting periods.

The growth hormone preparation had no influence on the level of blood reducing sugar or the quantity of reducing sugar excreted in the urine during ad libitum feeding periods or during periods of fast.

The values obtained for the normal distribution of the nitrogenous urine components of 6 to 8-week-old cockerels, expressed as percentages of the total urinary nitrogen, were 80.94, 10.63, 2.64, 0.59, 0.77 and 4.43 for uric acid, ammonia, urea, creatinine, creatine and undetermined nitrogen, respectively.

Microfilm \$2.50; Xerox \$6.20. 126 pages.

**TECHNIQUES FOR ASSAYING CIRCULATING GROWTH HORMONE IN BEEF CATTLE**

(L. C. Card No. Mic 60-5893)

Allen Herman Trenkle, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: Wise Burroughs

The purpose of this work was to develop a suitable technique for quantitatively measuring growth hormone in bovine blood which would aid in evaluating the pituitary hormonal regulation of growth. The two general methods used in this study were to concentrate the circulating growth hormone so it could be assayed by conventional methods and to assay serum for growth hormone with an immunological technique.

Growth hormone was concentrated sufficiently into a plasma fraction using a low-salt ethanol method such that it could be assayed in hypophysectomized rats using the tibia test. It was observed that the circulating growth hormone was precipitated from plasma at pH 5.4 or 4.5 which is more acid than the isoelectric point of purified pituitary growth hormone. Electrophoretic analysis indicated that most of the plasma alpha-globulin protein was also precipitated in this fraction. The use of this method for quantitatively measuring plasma growth hormone was limited, since all of the plasma hormone could not be concentrated into a single fraction suitable for biological assay in the experimental animals.

An immunochemical assay technique based upon complement fixation was used to detect as little as 0.025 microgram of purified bovine pituitary growth hormone. Antibodies for growth hormone were obtained by immunizing rabbits against bovine growth hormone with the aid of Freud's adjuvant. The specificity of the assay was studied by replacing growth hormone with several different plasma

fractions or ovine lactogenic hormone in the complement fixation reaction. Based upon the results of these studies, the assay was considered specific for growth hormone. Standard curves which were established by plotting the optical density of the hemoglobin released during the hemolysis reaction against quantities of purified growth hormone were linear over the range of zero to 0.15 microgram of hormone. This immunochemical assay technique had sufficient precision and sensitivity to measure the circulating growth hormone present in 0.2 milliliter of bovine serum.

The immunochemical assay technique and the rat tibia assay were compared by assaying a specific plasma fraction for growth hormone. Within the limits of experimental error, both methods gave similar estimates of the quantity of growth hormone.

Rather limited application of the immunochemical technique indicated that growth hormone concentrations in nonlactating and nonpregnant mature cows, two-year old heifers and one-year heifers were 5.0, 35.6 and 73.8 micrograms per 100 milliliters of serum respectively. The analysis of serum samples from mature lactating cows and their ten-week old male offspring indicated that there were individual differences in the concentration of circulating growth hormone but there were no differences due to age of these animals.

Although the immunochemical assay appeared specific in these studies it should be further investigated. It appears however that such a technique is fairly reliable as now developed for measuring circulating growth hormone and may in the future have many applications concerned with the pituitary regulation of growth of beef cattle.

Microfilm \$2.50; Xerox \$4.20. 77 pages.

#### SPECIFIC NUTRIENT ADDITIONS TO GREEN FORAGES IN THE PRODUCTION OF BLOAT IN SHEEP

(L. C. Card No. Mic 60-5894)

Donald Robert Warner, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: Wise Burroughs

Studies were conducted with lambs to determine the influence of various nutrients on the production of bloat when solutions of these materials were sprinkled on freshly chopped or cut alfalfa and when applied as a foliar spray to alfalfa pasture. Alfalfa forage samples were analyzed to determine possible relationships between changes in different nitrogen fractions due to the foliar application of nutrient materials and the incidence of bloat. Blood samples were analyzed for ammonia nitrogen and nonprotein nitrogen to study the effects of nutrient additions to alfalfa forage on blood nitrogen levels in conjunction with the frequency and degree of bloat.

When alfalfa soilage was fed to lambs only a slight amount of bloat occurred. Consequently, definite relationships between nutrient additions to the forage and production of bloat were not obtained during the soilage trials. There were indications that both nitrogen (urea additions) and sugar (corn syrup and glucose additions) might be

contributing to the production of bloat. Additions of egg white, potassium carbonate, sodium phosphate and phosphoric acid solutions did not affect the incidence of bloat.

Foliar applications of urea and glucose increased the frequency and degree of bloat in lambs grazing alfalfa pasture. Significant ( $P < 0.05$ ) increases in average maximum bloat scores were obtained from foliar applications of either urea or glucose alone and from a combination of urea and glucose. In two trials, average maximum bloat scores from foliar application of calcium carbonate were intermediate between those for control lambs and lambs grazing alfalfa that had been sprayed with glucose. Foliar application of potassium carbonate was deleterious to the growth and succulence of alfalfa pasture.

Forage samples were taken from control and foliar treated alfalfa plots at 24, 48, and in some cases 72 hours after spraying. The spraying of alfalfa with urea increased the total nitrogen content of alfalfa samples and the nitrogen soluble in 0.02 N. NaOH. There was no difference in the amount of trichloroacetic acid precipitable nitrogen between the control and urea-sprayed samples. This would indicate that the nitrogen increase found in the samples from alfalfa sprayed with urea was still in the form of nonprotein nitrogen. Spraying alfalfa with either glucose or calcium carbonate had little if any effect on the levels of nitrogen components determined in the alfalfa tops.

Urea solutions sprinkled on alfalfa soilage fed to lambs increased blood ammonia nitrogen levels. Lambs grazing urea-sprayed alfalfa had higher average blood nonprotein nitrogen levels than control lambs. Other nutrient additions, either sprinkled on alfalfa soilage just prior to feeding or sprayed on alfalfa pasture, did not noticeably change the blood nitrogen components determined. Data obtained did not indicate a positive relationship between levels of blood nitrogen components and the degree of bloat in lambs.

Microfilm \$2.50; Xerox \$5.60. 112 pages.

#### SOME FACTORS AFFECTING TENDERNESS OF POULTRY MEAT

(L. C. Card No. Mic 60-4225)

Raymond Genio Wise, Ph.D.

Purdue University, 1960

Major Professor: W. J. Stadelman

Five experiments were conducted to find out when, where and why toughness of poultry meat develops as a result of the scalding process. Factors studied included the effect of scald time, scald temperature, skin presence, time lapse from slaughter, and, in addition, an ante-mortem treatment involving the use of pentobarbital sodium (Nembutal). These factors were studied primarily with respect to their effect on the resistance to shear of certain designated skeletal muscles and positions within these muscles of the poultry carcass. The first four experiments used young turkey hens because muscles under consideration were much larger, enabling more detailed study, than those of other classes of poultry.

Under normal scalding conditions of 90 seconds at



140°F., skin presence was found to significantly decrease the scald toughening effect. Birds which had been aged for 24 hours and then scalded for up to 5 minutes at 140°F. were not toughened, with skin present or not. The presence of skin reduced the scald toughening effect on birds scalded for 5 minutes at 140°F. and then aged.

Significant variation in tenderness level was obtained at varying muscle depth layers due to the combined effects of temperature and time duration of the scald process. Skeletal muscle tissue within the exterior 6 mm. was toughened at a different rate at temperatures above 122°F. than at deeper levels of tissue at the same temperature when the effect of scald time was held constant at 12.0 minutes.

Significant variation in tenderness of skeletal muscle tissue as indicated by a lack of resistance to shear was found by measurements on both raw and cooked biceps femoris thigh muscle and also pectoralis superficialis breast muscle.

The tenderization pattern for skeletal muscle immobilized by pentobarbital sodium was found to be significantly different than for similar non-immobilized tissue. The immobilized muscle had a lower initial resistance to shear and a less fluctuating but higher level of resistance to shear during the post-mortem period of 3.0 to 12.0 hours.

It was concluded that the toughening effect of excessive scalding is a direct function of the tissue temperature during the early post-mortem period. A theoretical explanation was offered for the mechanism of permanent toughening effect.

Microfilm \$2.50; Xerox \$4.80. 92 pages.

#### CALCIUM AND PHOSPHORUS STUDIES WITH BABY PIGS

(L. C. Card No. Mic 60-4912)

Dean Roland Zimmerman, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisors: Damon V. Catron and Vaughn C. Speer

A series of 7 experiments involving 196 pigs from 2-6 or 2-7 weeks of age was conducted to study the influence of various levels and ratios of calcium and phosphorus in the ration on performance. Calcium was supplied by calcium carbonate and phosphorus by monocalcium phosphate. Criteria of performance were growth rate, efficiency of feed utilization and bone calcification estimated by optical bone density values obtained from radiographs and by percent ash values of moisture- and fat-free bones. Calcium retention was also used as a criterion in one experiment. In all but one of the experiments high milk product rations (25 percent dried skim milk equivalent) were used.

It appeared that calcium:phosphorus ratios over the range from 0.75:1.0 to 2.0:1.0 had little influence on baby pig performance, while calcium levels over the range from 0.5 to 1.0 percent of the ration had a decided effect. Calcium levels higher than 0.8 percent in high milk product rations adversely influenced the growth rate and the efficiency of feed utilization, however, with a corn-soybean oil meal type ration these adverse effects were

not evident. In some cases 0.5 percent calcium in the ration appeared to be inadequate for maximum growth rate and efficiency of feed utilization. In all but one experiment bone calcification was increased by calcium levels up to 0.9-1.0 percent of the ration. The calcium balance data of one experiment indicated an increase in total calcium retained with rations containing up to 0.9 percent calcium.

In one experiment the phosphorus requirements for maximum growth rate, efficiency of feed utilization and bone calcification were 0.55, 0.65 and 0.55 percent, respectively, in a high milk product ration containing approximately 0.10 percent phytin phosphorus. With the corn-soybean oil meal type ration containing normally adequate calcium, 1.0 percent phosphorus inhibited maximum bone calcification.

Possible explanations for the adverse effects of high calcium intakes were investigated in two experiments. Neither an observed poor chlortetracycline absorption with high calcium intakes nor the presence of a large quantity of the carbonate anion in the ration were found responsible for the inferior performance.

A statistical comparison of the criteria used for estimating bone calcification revealed that the percent metatarsal ash was slightly more precise than the optical bone density--fewer replications would be needed to demonstrate statistically significant treatment differences.

Microfilm \$2.50; Xerox \$5.60. 112 pages.

#### AGRICULTURE, FORESTRY AND WILDLIFE

##### FACTORS AFFECTING THE INCIDENCE OF REACTION TISSUE IN POPULUS DELTOIDES BARTR.

(L. C. Card No. Mic 60-4889)

Graeme Pierce Berlyn, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisors: Dwight W. Bense and John E. Sass

The present investigation was undertaken to provide information on the effect of various intrinsic and environmental factors on the incidence of tension wood in Populus deltoides Bartr. Tension wood is a form of reaction tissue which occurs on the upper side of leaning angiosperm stems. It is characterized by fiber tracheids which possess an unligified, gelatinous-appearing, cellulosic layer in their cell walls. Fourteen bottomland cottonwood stands growing on previously studied soils were used in this study. The average age of the timber was 46 years. Three large cores of tissue were extracted from the upper side of each of 84 trees at breast height. The external morphological features of each of the trees were measured and described.

A quantitative histological analysis was developed. Images of cross sections including the cambium and 3 annual increments were projected on paper grid systems. Counts of stimulated and nonstimulated cells in randomly selected grid squares were recorded.

The induction of the gelatinous layer occurs early in cellular ontogeny, i.e. the layer may be observed immediately subjacent to the cambium. The cambium



produces gelatinous fibers in small groups (unless 100 per cent reaction occurs), but abrupt variations occur. The proportion of gelatinous fibers is positively correlated with radial growth and the number of cells per unit area. There is a depression of vessel size in reaction tissue. Strong fluctuation in the factors which determine radial growth are associated with equally strong fluctuation in the factors that induce reaction tissue. This association is limited to certain metabolic intervals as expressed by radial growth. The absolute nature of the cytological response and the distributional form of the histological response suggest a chemical feedback mechanism, possibly mediated by hormonal levels.

A study of the form and distribution of the data was made. Weighted means of samples of 8 grid squares were 129 percent more efficient than unweighted means. The variance associated with reaction tissue was significantly greater than binomial variance. Untransformed data were shown to provide more information than either the arcsine or square root transformed data. Significant but small positive correlation exists between adjacent squares and significant but small negative correlation exists between distant squares. This suggests that random sampling may be improved upon by utilizing the low variance associated with negative correlation. Selection of grid squares at the vertices of suitable, randomly placed geometrical figures is suggested.

In multiple regression analyses, lean, crown volume, and available phosphorus were found to be highly significantly related to the proportion of gelatinous fibers. Crown volume was also an excellent correlate with many other growth variables. The phosphorus relationship may stem from its role in cellulose synthesis. In tension wood cellulose biosynthesis is stimulated and lignin biosynthesis is depressed. This needs to be checked at more critical levels of phosphorus. Lean was clearly the strongest correlate. For the age and ecological situations of the trees examined in this study there appeared to be one over-all regression coefficient for the proportion of gelatinous fibers regressed on lean. The rate and capacity for reaction tissue production in woody plants are depressed with the onset of senescence, the duration of stimulus, and the cyclic levelling off of diameter growth.

Microfilm \$2.50; Xerox \$7.60. 164 pages.

**A STUDY OF THE FACTORS  
INFLUENCING WATERFOWL CENSUSES  
IN THE PARKLANDS, ALBERTA, CANADA.**

(L. C. Card No. Mic 60-4423)

Kenneth L. Diem, Ph.D.  
Utah State University, 1958

Major Professor: Dr. Jessop B. Low

Proper management of the valuable waterfowl resource of North America requires reasonably accurate information about the size and composition of the waterfowl populations. This study was conducted during the waterfowl breeding seasons of 1955-57 in the parklands at Lousana, Alberta, Canada, to determine which waterfowl census procedure provided the most reliable index to the size and composition of the fall flight of waterfowl.

Counts were made of the breeding populations and brood populations by ground beat-out, roadside, and aerial censuses. The influences of waterfowl characteristics, phenological developments, human error, time-of-day, and weather conditions on these census procedures were investigated in detail.

The optimum time to initiate the waterfowl breeding census on the Lousana area was well-correlated with the catkin stage of the willow and the "mouse-eared" leaf stage of the aspen. An analysis of variance of breeding population and brood population census data indicate that the mallard and the "motilepuddlers" counts were significantly higher between 5:30 a.m. and 9:30 p.m. Other species of waterfowl were counted in equal numbers at all times of the day. Temperature was found to be a significant weather factor influencing the countability of puddler ducks.

Detection of increasing or decreasing waterfowl populations and their production, as it occurs among species, is impossible with present aerial waterfowl census procedures. The magnitude of errors of population estimates, based on aerial censuses, may be as high as 65 per cent.

It is recommended that administrative adjustments, rather than mathematical adjustments be made to correct for the unknown influence of changing transect locations, use of trained personnel, improper timing of censuses with phenological developments, and reshuffling of experienced census personnel from familiar areas to strange areas.

A mathematical adjustment by aerial-ground indices is necessary to adjust simultaneously and uniformly for the environmental changes which now go uncorrected. Particularly important to brood census, these adjustments indices provide for: (1) broods per species, (2) number of ducklings per brood in all age classes, and (3) extent of late hatching.

Microfilm \$2.50; Xerox \$4.60. 89 pages.

**AN ECOLOGICAL STUDY OF  
THE BOTTOM FAUNA OF BEAR LAKE,  
IDAHO AND UTAH.**

(L. C. Card No. Mic 60-4425)

Earl W. Smart, Ph.D.  
Utah State University, 1958

Major Professor: William F. Sigler

From 1953 to 1956 the macroscopic bottom organisms of Bear Lake were sampled with more than 400 dredgings. Additional ecological information was obtained from qualitative collections and from the examination of stomach contents of fish.

For sampling, the bottom was arbitrarily divided into three zones based on bottom types: sand, 0-40 feet; silt-sand, 40-100 feet; silt-marl, deeper than 100 feet. The bottom forms of each type were described with an accuracy of  $\pm$  ten percent with the risk of being wrong one third of the time.

Bear Lake is a typical oligotrophic lake. The predominating bottom fauna are aquatic oligochaetes and chironomid larvae. It is deep blue because of the lack of organic matter.

The average bottom population for the whole lake is 568 per square yard, 2385.3 mg. per square yard and 23.7 pounds

per acre. In this respect Bear Lake compares closely with Lake Nipigon, Canada.

Bear Lake has a surface area of 110 square miles and a weighted average depth of 108 feet at 5923.65 feet above sea level, the maximum level of the lake. The lake was sounded with a recording fathometer. The fathometer graphs indicate a very uniform bottom with fluid silt in the deep portions. The deepest point in the lake was 197 feet at the lake level of 5915 feet above sea level or a depth of 205 feet at the maximum level of the lake.

The productivity of Bear Lake appears to be dominated by the morphological conditions of the lake.

Microfilm \$2.50; Xerox \$4.80. 95 pages.

## AGRICULTURE, PLANT CULTURE

### THE EFFECT OF CHLORIDE, SULPHATE, AND TEMPERATURE ON THE RATE OF PHOSPHATE UPTAKE BY CORN *Zea mays* L.

(L. C. Card No. Mic 60-6463)

Owen Graham Carter, Ph.D.  
Cornell University, 1960

Potassium fertilizer trials conducted at Cornell University have indicated that chloride ion delays maturity and reduces ear corn yield when high rates of potassium chloride fertilizer have been used. One of the effects of high rates of chloride was a reduction in the phosphate content of the corn plants.

The major objective of this study was to determine whether chloride ion has any direct effect on the rate of phosphate uptake by corn roots. The experiments were designed so as to allow application of chemical kinetics to the data obtained to determine the possible nature of any effects.

Two major types of plant material were utilized; (1) excised roots of ninety hour old corn plants grown in the dark on sand moistened with  $2 \times 10^{-4}$  M  $\text{CaSO}_4$  and (2) twenty day old corn plants grown in mineral nutrient solution containing only 4 ppm of phosphorus in a growth chamber. The latter corn plants were used both intact and with the tops removed. Tracer techniques using  $\text{P}^{32}$  were used throughout the study.

The experiments indicated that neither KCl nor  $\text{K}_2\text{SO}_4$  influenced the rate of phosphorus uptake during a four hour time period throughout the range of phosphorus concentrations from  $1 \times 10^{-6}$  M to  $256 \times 10^{-6}$  M.

A second part of this project was to determine the effect of temperature on the rate of phosphorus uptake by excised corn roots. The experiments were conducted in such a way as to allow the application of chemical kinetics to the results obtained. It was thought that one of the so-called "sites" of phosphorus uptake in plant roots may be the result of some nontemperature dependent diffusion phenomena which becomes limiting at low phosphate concentrations.

The rate of phosphorus uptake associated with both sites of phosphorus uptake were found to be highly temperature dependent and to have a  $Q_{10}$  of the order of 2-3.

The kinetic constants obtained were used to calculate the  $\Delta F^\circ$ ,  $\Delta H^\circ$  and A values for the two sites of phosphorus uptake. The following values were obtained:

	Site a	Site b
	calories per mole	
$\Delta H^\circ$	-1,156	-13,282
$\Delta F^\circ$	-5,366	- 7,240
A	11,958	14,835

The  $\Delta H^\circ$  value was obtained from an Arrhenius plot of  $\log. \frac{1}{K_m}$  against the reciprocal of absolute temperature and the A value was based on an Arrhenius plot of  $\log. V_{max}$  against the reciprocal of absolute temperature. These thermodynamic calculations indicated that two independent chemical reactions were involved in phosphorus uptake by excised corn roots.

Microfilm \$2.65; Xerox \$9.25. 204 pages.

### EVALUATING GRASS SYNTHETICS AND VARIETIES

(L. C. Card No. Mic 60-5422)

Richard Herman Cole, Ph.D.  
The Pennsylvania State University, 1960

Eleven grass varieties and synthetics were seeded at three Pennsylvania locations in three associations under two cutting management treatments. Interactions were computed and tested to determine a satisfactory procedure for evaluation of grass synthetics and varieties. Aspects of forage quality, the use of characters other than total annual dry matter yield and forage quality, and the performance of association and cutting management treatments were investigated. Analyses of three years' data were made to test the significance of differences in performance among the orchardgrass, timothy, and bromegrass varieties and synthetics.

A row nursery of the eight early, medium and late maturing orchardgrasses, one timothy and two bromegrass entries was used to estimate characters not easily evaluated in broadcast experiments. Grasses seeded alone received forty pounds of nitrogen per acre each spring and after each cutting except the last cut in the fall. Maintenance applications of phosphorus and potash fertilizer were applied annually to all plots.

Significant interactions between varieties and associations were found for most analyses of all characters with the exception of grass fraction yields and per cent crude protein. From the data presented it would appear desirable to evaluate varieties and synthetics both as grass alone and in legume associations in which they are likely to be seeded.

Very few significant varieties x managements interactions were found to be significant. There is no necessity of testing grass synthetics varieties before release under other than a practical cutting management system.

Analyses of per cent crude protein and per cent crude fiber and computation of TDN by Axelson's formula were



made. To differentiate entries on the basis of major differences in crude protein, preliminary evaluation may be confined to analyses of first harvest forage. No advantages were found for compositing forage samples for each harvest into a single sample.

Evaluation of characters other than total annual yield and forage quality gave information that proved useful in determining grass variety and synthetic value. Additional separations among high yielding grass varieties and synthetics were possible.

Significant differences in performance among the eleven grass varieties were found. The data obtained indicates that of the grass varieties presently recommended for use in Pennsylvania, Potomac and Pennlate orchardgrass and Saratoga bromegrass warrant continued recommendation. Grass varieties presently recommended for use that should be reclassified are S-37 orchardgrass, Climax timothy and Lincoln bromegrass. The performance of Pa. Medium Syn. II, an experimental orchardgrass, was such as to suggest that it be considered for release and recommended for use in Pennsylvania.

Total annual yields were greater under a three cut management than a four cut management. Forage quality and distribution were superior under a four cut management. No association could be classified as superior to any other association. Significant interactions were obtained among associations, cuts, years, and managements. Microfilm \$2.50; Xerox \$4.60. 86 pages.

#### INDUCED ENDOSPERM MUTATIONS IN MAIZE

(L. C. Card No. Mic 60-4162)

Roy Glynn Creech, Ph.D.  
Purdue University, 1960

Major Professor: Herbert H. Kramer

A new endosperm texture mutant, termed translucent, was observed in *Ds*-*Ac* (Dissociation-Activator) material by N. K. Notani in 1957. The mutant was interesting because it raised the amylose fraction of the starch in the endosperm. The purpose of the present study was to determine if translucent differed from the previously known endosperm texture mutants and whether or not it was induced by *Ds*-*Ac*.

When translucent was outcrossed with a series of allele testers, positive tests were obtained with *ae* (amylose extender on chromosome 5) and *su*<sub>2</sub> (*sugary*<sub>2</sub> on chromosome 6). These apparent alleles of *ae* and *su*<sub>2</sub> were termed *ae*<sub>i</sub> (*ae* induced) and *su*<sub>2i</sub> (*su*<sub>2</sub> induced), respectively.

Tests were carried out on both *ae*<sub>i</sub> and *su*<sub>2i</sub> to determine if they differed from the standard alleles *ae* and *su*<sub>2</sub>. Starch tests were made for comparisons in regard to amylose content and birefringence end-point temperatures. Phenotypes were compared. Pseudoallele tests were performed to test for recombination between the induced mutants and the standard mutants. Tests were devised in an attempt to determine whether or not *Ds*-*Ac* activity induced *ae* and *su*<sub>2i</sub>.

Data obtained in this study indicated that *ae*<sub>i</sub> was different from *ae* in interactions for amylose content with

*su*<sub>2</sub> and *wx*. The gene *su*<sub>2i</sub> appeared to be different from *su*<sub>2</sub> in normal and *su*<sub>1</sub> backgrounds. No major differences were noted in phenotypes and starch birefringence end-point temperatures.

A pollen-staining technique was devised which may allow a study of recombination at the *ae* locus. It was found by overstaining pollen from a plant with the genotype *wx/wx Ae/ae* with an iodine-potassium iodide solution, and by destaining slightly, one could differentiate the *wx Ae* from the *wx ae* pollen. The *wx Ae* pollen stained red because of the absence of amylose and the *wx ae* pollen stained black because of the presence of amylose. Preliminary studies with *wx ae*, *wx ae*<sub>i</sub>, and *wx ae/ae*<sub>i</sub> cultures are reported. Recombination between *ae* and *ae*<sub>i</sub> could not be determined at this time because of the high frequency of natural-occurring red-staining pollen grains in the parental lines.

Tests for *Ds* at the *ae*<sub>i</sub> and *su*<sub>2i</sub> loci were not conclusive. However, it was indicated that *Ac* was not present at the *ae*<sub>i</sub> locus.

Microfilm \$2.50; Xerox \$4.40. 84 pages.

#### LEAF AREA STUDIES IN TALL FESCUE (*Festuca arundinacea* Schreb.)

(L. C. Card No. Mic 60-4170)

Hiram Grove, Ph.D.  
Purdue University, 1960

Major Professor: Dr. G. O. Mott

An experiment was conducted at the Purdue University Agronomy Farm, Lafayette, Indiana, during the summer and fall of 1959. In a tall fescue pasture, the leaf area index (LAI), the percent light intercepted by the foliage, and the dry matter production were determined at weekly intervals during four different eight week periods.

The first replication in time (treatment) was started on June 1, and the following three treatments were started every four weeks thereafter. Each treatment had three replications in space. The pasture was adequately supplied with fertilizers and with water to ensure that production was not limited by these factors.

The light interception-time pattern was similar for all four treatments. The dry matter accumulation-time pattern was similar for the first three treatments; but the last treatment, started on August 24, showed a lower rate of dry matter accumulation. The rate in leaf area increase diminished from one treatment to the next as the growing season progressed from early summer to late fall. Plant growth efficiency, expressed either as net assimilation rate or as relative growth rate, diminished with time within each treatment. It also diminished for the last treatment as a whole when compared to the other three preceding treatments.

The general dependence of dry matter accumulation on LAI, as has been proposed by the LAI theory, was observed in this study. However, other physiological factors, at certain developmental stages of a perennial grass pasture, have a profound influence on this relationship. Reproductive growth and the formation and re-utilization of root reserves are indicated as two important aspects of

plant development that interfere with the relationship between LAI and dry matter accumulation.

Based on the results of this study and on related data published by several workers, a tentative scheme is given for the interrelationships LAI - percent light interception - dry matter accumulation occurring in a dominantly grass permanent pasture.

Microfilm \$2.50; Xerox \$5.00. 99 pages.

# LINKAGE STUDIES IN CHROMOSOME 5 IN MAIZE WITH SPECIAL REFERENCE TO THE GENE *ae*

(L. C. Card No. Mic 60-4179)

Johnie Norton Jenkins, Ph.D.  
Purdue University, 1960

Major Professor: H. H. Kramer

Experiments were conducted to determine the genetic and cytological position of *ae* on chromosome 5. Genetic markers *a<sub>2</sub>*, *bm<sub>1</sub>*, *bt<sub>1</sub>*, *v<sub>3</sub>*, *bv*, *pr* were utilized. T4-5c, T4-5f, and T4-5g, were used as cytological markers. The *v<sub>3</sub>-ae-pr* and *bv-ae-pr* data allowed *ae* to be placed at map position 32 and *pr* moved to 46. The T4-5c data placed the cytological locus of *ae* very near L. 27. T4-5f was distal to *ae* and T4-5g was shown to be in the short arm of chromosome 5. This cleared up a discrepancy as to its break position.

The *bm<sub>1</sub>-ae-pr* data showed differential transmission of the wild type and recessive alleles at the *ae* locus through the eggs. In the *bv-ae-pr* data there was an excess of two strand double cross overs and an excess of double cross overs. A necrotic lethal seedling was shown to be independent of *ae* and *pr*.

Studies were also conducted on a transmission anomaly of the wild type and recessive allele at the *ae* locus. Differential transmission of both alleles through the pollen and eggs were observed. A gametophyte factor was proposed to account for the pollen behavior. To account for the differential transmission through the eggs a genic element causing either (1) preferential segregation of the particular genotype into the basal megaspore or (2) preferential development of the spore with the particular genotype regardless of its position in the linear tetrad was proposed. It was shown that this behavior through the eggs was probably not due to a cytoplasmic factor.

A color mutant picked up during the course of investigations proved to be due to *R* mutating to *r*. A light yellow endosperm color was shown to be due to a single dominant gene on chromosome 5. It showed 19 per cent recombination with *ae*. Pale green (chromosome unknown) and *gs* proved not to be allelic. Several stocks were established which should be of value for further work with chromosome 5.

Microfilm \$2.50; Xerox \$5.80. 120 pages.

# GAS AND PAPER CHROMATOGRAPHY OF VOLATILE FLAVOR CONSTITUENTS OF SEVERAL VEGETABLES

(L. C. Card No. Mic 60-6507)

Richard Finis Matthews, Ph.D.  
Cornell University, 1960

By gas chromatographic analysis acetaldehyde, propionaldehyde, butyraldehyde, valeraldehyde, hexaldehyde, methanol, ethanol, pentanol, and heptanol were identified as volatile flavor compounds from snap beans. Paper chromatographic analyses of carbonyl derivatives were used to identify formaldehyde, acetaldehyde, propionaldehyde, butyraldehyde, and hexaldehyde from snap beans.

Identification of acetaldehyde, methanol, and ethanol as volatile compounds from peas was made with gas chromatographic analysis. Paper chromatographic analysis of carbonyl derivatives indicated the presence of acetaldehyde, propionaldehyde, and furfural as volatiles from peas. Two carbonyls of molecular weights higher than that of those mentioned were shown to be present in the volatiles from peas, but were not identified.

Furfural, acetaldehyde, and acetone were identified as volatile carbonyls from ripe tomatoes by paper chromatography.

In the paper chromatography of the 2,4-dinitrophenylhydrazine derivatives of the carbonyl compounds *n,n*-dimethylformamide was utilized as the stationary phase and cyclohexane as the mobile phase. The gas chromatography was done with a Perkin-Elmer 154-C Vapor Fractionator, modified to permit sampling of U-tubes with the gas-sampling accessory and to prevent premature condensation of the volatile fractions in the exit gas assembly. The column substrates used for the majority of the analyses were polyethylene glycol 1500 and tetraethylene glycol dimethyl ether.

The volatile compounds were obtained from vegetables by high vacuum (approximately one mm. mercury) distillation at room temperature and the volatiles were condensed in U-tube cold traps. Cold-baths used were a dry ice-methyl Cellosolve bath and a liquid nitrogen bath in series. The volatile compounds were also obtained from vegetable tissue by steam distillation and ether extraction of the aqueous distillate. A rapid analysis of juice pressed from vegetables was attempted by analysing the gas from above a juice sample held in a heated U-tube. This attempt was unsuccessful on account of the high percentage of water vapor which interfered with the analysis.

A storage test was made with the Tendergreen variety snap bean. Storage periods of 0, 1, 5, 7 and 9 days were established for 32° F., 50° F., and 70° F. The beans were steam distilled and the ether extract of the aqueous distillate analyzed by gas chromatography. The qualitative composition of the snap beans showed no change during storage. Propionaldehyde content increased during storage at 32° F.

A comparison of 5 snap bean varieties was conducted. The varieties were Black Valentine, Longval, Slenderwhite, Extender, and Tenderwhite. The beans were steam distilled and the ether extract of the distillate analyzed by gas chromatography. The varieties were similar in their quantitative and qualitative composition.

Bean oil (2.0 ml.) from the steam distillation of 150 pounds of snap beans was fractionated into 19 peaks by gas



chromatography. The fractions were condensed from the effluent gas by cold trapping. The individual peaks were characterized as to odor and tested for functional groups. The larger peaks (total condensate approximately ten microliters) were analyzed by infrared spectrometry. Compounds from all peaks gave a negative ester test. One peak possessed the odor of green snap beans. The compound from this peak gave negative tests for acid, aromatic, carbonyl, and ester groups and a positive test for the alcohol group. Infrared analysis of this compound gave strong absorption bands with major peaks corresponding to intermolecular hydrogen bonds of hydroxyl groups and unsaturation of a terminal carbon atom. The gas chromatographic retention time of this compound was equivalent to an eight-carbon n-alcohol.

Some workers believe that the blanch process prior to canning snap beans results in the loss of the "green" taste. Blanched and unblanched snap beans were steam distilled and analyzed by gas chromatography. The total quantity of bean oil from the ether extract was less in the blanched than in the unblanched beans. The gas chromatographic analysis showed a definite reduction in the higher boiling components of the bean oil from the blanched beans.

Microfilm \$2.50; Xerox \$5.60. 113 pages.

#### SOYBEAN YIELD RESPONSES AND PLANT COMPOSITION AS AFFECTED BY PHOSPHORUS AND POTASSIUM FERTILIZERS

(L. C. Card No. Mic 60-4902)

Robert Joseph Miller, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: John T. Pesek

The effects of P and K fertilizers on soybean yields and the chemical composition of the plants were investigated in four experiments conducted in Iowa in 1958. The P and K composition of lower and upper leaves and petioles sampled in growth stages 5, 7 and 9 (from flower initiation through seed set) were used as the independent variables in the multiple regression analyses. The yield and chemical composition of soybean plants in each experiment were determined from 22 different P and K fertilizer treatments, each replicated twice.

The simple relationships between yield and chemical composition of the various plant parts were determined by linear regression and the deviations from linearity were estimated by plotting the group means of the observations. Interactions between percent P and percent K on yield were investigated by determining the relationship between yield and percent P at two different levels of percent K and between yield and percent K at two different levels of percent P in the upper soybean leaves. A significant interaction was found in only one experiment.

Two forms of the polynomial function, the quadratic equation with squared terms and a linear x linear interaction term and a square root transformation of the quadratic equation with a square root x square root interaction term, were used to express the curvilinear relationships between yield and the chemical composition of the soybean plant parts. The multiple regression equations, standard

errors of the partial regression coefficients and  $R^2$  values for the various soybean plant parts sampled in the different growth stages were first calculated for individual experiments for both forms of the regression equations.

Since the  $R^2$  values for the various plant parts were lower in growth stage 9 than in growth stages 5 and 7, the data for growth stage 9 were deleted in the subsequent multiple regression analyses. Comparison of the  $R^2$  values indicated that no one plant part nor form of the regression equation showed a consistently better relationship between yield and chemical composition than any of the others.

The data for the lower and upper leaves and petioles sampled in growth stages 5 and 7 for three experiments were combined for multiple regression analyses.

The corresponding  $R^2$  values obtained for the two forms of regression equations showed similar trends among the various plant parts sampled in growth stages 5 and 7. The  $R^2$  values for the square root equations were a little higher than those for the quadratic equations for all plant parts in growth stage 5 and for the lower petioles in growth stage 7. There was no difference between the two forms of the equations for the other plant parts in growth stage 7.

Although the results were somewhat variable, it was possible to explain from 12% to 95% of the variation in yield in the individual experiments and from 55% to 74% in the combined experiments by the multiple regression equations containing only 5 fixed variates.

Microfilm \$2.50; Xerox \$8.20. 176 pages.

#### FACTORS AFFECTING THE MOVEMENT OF POTASSIUM IN MINERAL SOILS

(L. C. Card No. Mic 60-5141)

Clifford Newell Nolan, Ph.D.

The University of Florida, 1960

A series of experiments were conducted in large lysimeters, in the greenhouse, and in the laboratory to study certain factors related to leaching of potassium from mineral soils. Three soils were used in this study; Arredondo fine sand in the lysimeter and greenhouse, Lakeland fine sand in the greenhouse and laboratory, and Red Bay loamy fine sand in the laboratory experiments. The following variables were investigated and their relationship to potassium leaching discussed; soil cover, rates and methods of application of potassium fertilizers, leaching intensity, particle size and water solubility of potassium materials, and soil reaction.

Crops growing on the soil reduced the leaching losses of potassium in outdoor and greenhouse-lysimeter experiments. This reduction in leaching losses of potassium by crops was effected through a reduction in the amount of gravitational water passing through the soil and by the absorption of fertilizer potassium into the plant tissues. Fibrous rooted crops (oats and millet) were more effective in reducing the leaching losses of potassium, applied as KCl, than were shallow, rooted crops (cabbage and sweet potatoes). Millet and radish crops significantly reduced the amounts of potassium leached from a top-dressed application of KCl on Lakeland fine sand.

Potassium losses from Arredondo fine sand in outdoor

lysimeters increased with each increment of KCl added to cropped and fallow soils. Potassium leaching losses were greater from band placement of KCl than from a broadcast application on sweet potatoes grown in Arredondo fine sand in outdoor lysimeters.

The anion associated with potassium materials significantly influenced the leaching of potassium from 7 fertilizer materials. Potassium leaching losses from Lakeland fine sand in a greenhouse experiment were in the following order:  $\text{KNO}_3 > \text{KCl} > \text{K}_2\text{SO}_4 > \text{KH}_2\text{PO}_4 > \text{KPO}_3$  (99.7 percent water soluble)  $> \text{KPO}_3$  (13.7 percent water soluble)  $> \text{K}_2\text{CO}_3$ . Potassium losses by leaching were very low from the potassium phosphates and potassium carbonate materials. The relative retention of the various anions in the soils significantly affected the leaching losses of potassium. Chlorides leached very rapidly from fallow or cropped soils. Nitrates leached very readily from the fallow soils; however, its rate of leaching was greatly reduced under crop growth. The sulfate anion was retained more strongly in the soils than the chloride or nitrate anions. Only traces of phosphorus were found in the leachates from any treatment.

Water solubility of potassium materials did not significantly affect the leaching of potassium from the soil. Increasing particle size increased the leaching of potassium from a completely water soluble KCl. The effect of particle size of slightly water soluble  $\text{KPO}_3$  and  $\text{K}_2\text{CaP}_2\text{O}_7$  on the leaching of potassium was not significant.

Soil reaction significantly influenced the amounts of potassium retained in Lakeland fine sand in a laboratory study. A pH of 6.5 was found to be the most favorable soil reaction for the retention of applied potassium. The amounts of potassium lost from a Red Bay soil were relatively small, even at low pH levels; however, the influence of pH on potassium losses from this soil was similar to that observed with Lakeland fine sand.

Microfilm \$2.50; Xerox \$6.80. 142 pages.

# FACTORS INFLUENCING THE ESTABLISHMENT OF SEVERAL FORAGE CROP SPECIES

(L. C. Card No. Mic 60-5453)

Richard McCarthy Patterson, Ph.D.  
The Pennsylvania State University, 1960

Failure to obtain satisfactory stands of forage species has plagued the livestock and general farmer throughout the years. Besides the loss of direct expenses for fertilizer, seed, labor and operation of machinery, failures of forage seedings disrupt the farming program and necessitate alternative feeding arrangements.

Field studies were initiated to determine the effects of a few factors on the establishment of associations of alfalfa with smooth brome grass, Ladino clover with orchardgrass, and birdsfoot trefoil with timothy. Specifically, some effects of the following were determined and evaluated:

- (a) an oat companion crop utilized in several ways,
- (b) clipping forage species to control weeds during the seedling year, (c) methods of seed and fertilizer placement and fertilizer levels, and (d) dates of seeding.

The 1954 and 1955 seeding experiments were located

on a Hagerstown silt loam of medium fertility, but low in readily available  $\text{P}_2\text{O}_5$ . Seedlings were made in April except for the date of seeding experiment. Only the alfalfa-brome association was seeded in the seed and fertilizer placement-fertilizer levels study.

Results were evaluated in terms of plant stands, tillering, regenerative tissue development, and yields of seeded forage species. Establishment of the forage species also was related to competition from broadleaf and grass weeds and to climatic factors as expressed by daily precipitation and temperature records.

An oat companion crop slightly reduced stands, tillering, regenerative tissue development, and weeds but did not greatly affect forage yields. Clipping the oats twice at the pasture stage, once at the silage stage, or leaving a 2-inch or 6-inch stubble when harvesting grain did not affect stands, development of regenerative tissue or yields of seeded forage species. Clipping stimulated early tillering of the forages. The legume component yields were greatest when a 2-inch stubble was left after grain harvest. The best grass yields were obtained when their legume associates yielded the least.

When sown without oats the alfalfa-brome and Ladino-orchard associations yielded best when clipped once early or twice during the seedling year. The highest yield of trefoil-timothy was produced when clipped once late. All of the clipping treatments produced higher forage yields than the unclipped checks in the first harvest year.

Broadcast seed placement in 1954 produced superior stands, tillering, regenerative tissue development, and yields of alfalfa while drilled placement was best in 1955, an unfavorable seeding year. Drilled seed placement favored establishment of brome grass in both years. More weeds were present in the broadcast seedings of alfalfa and brome both years.

Alfalfa establishment was not greatly influenced by fertilizer placement in either 1954 or 1955. In 1954 brome plants tillered more and were larger when fertilizer was banded. This was not true in 1955. Broadleaf weeds were more numerous when fertilizer was broadcast in 1955.

There were no yield differences for the alfalfa-brome-grass association among the 0-40-0, 0-80-0, 0-40-40, and 0-80-80 pounds per acre fertilizer levels, but all were superior to no fertilization. Alfalfa stands were better in 1954 when 80 pounds fertilizer equivalent of  $\text{P}_2\text{O}_5$  per acre were applied. In 1955 brome plants developed best when potassium fertilizer was used.

In 1954, a favorable year, tillering and regenerative tissue development and subsequent yields decreased as seeding dates advanced from spring to fall. In 1955 spring seedings were unsuccessful because of drought whereas summer seedings became well established, and fall seedings were similar to those in 1954.

These experiments have shown that oats are competitive, but in some instances beneficial to forage crop establishment. The competition of oats or weeds may be controlled by clipping. Seed placement was identified as an important factor in establishment. Time of seeding was found to be important only as it relates to environmental conditions or length of the growing season.

Microfilm \$2.65; Xerox \$9.25. 204 pages.



# INHERITANCE AND EXPRESSION OF LOOSE SMUT RESISTANCE IN WHEAT

(L. C. Card No. Mic 60-6128)

Harry Randolph Richards, Ph.D.  
Purdue University, 1960

Major Professor: Fred L. Patterson

A thorough understanding of the inheritance of resistance to loose smut in wheat caused by *Ustilago tritici* (Pers.) Rostr. allows the wheat breeder to more effectively transfer resistance into agronomically desirable varieties. Knowledge of whether or not resistances from various varietal sources are controlled by allelic or non-allelic factors prevents costly and unnecessary duplication of breeding work. An attempt was made in this study to determine the dominance-recessiveness relationships of genes for resistance, to determine the number of genes controlling resistance, and to determine the allelic relationships of resistant genes in some varieties of winter wheat. The type of resistance in the Todd variety was investigated.

The resistance of Todd and Kawvale to race 6 was found to be controlled by at least two factors when crosses of these two varieties with Knox and Clarkan were studied. From a cross between Richelle and Knox, the resistance of Richelle to race 6 was shown to be conditioned by at least two factor pairs. The susceptibility of Clarkan and Knox to race 6 was incompletely dominant, regardless of the cross studied.

Two factor pairs were postulated as controlling the resistance of Todd and Kawvale to race 11 when the crosses of these varieties with Clarkan were studied. The resistant factors in each of the two varieties appeared completely dominant.

Todd and Kawvale appeared to have different factors for resistance to race 6. However, they possessed genes in common or at the same loci for resistance to race 11.

Results indicated that the factors for resistance to race 6 of Kawvale, Richelle, Purdue 4126A9-33-1-2-3-1-1-1-1, and Purdue 4126A9-16-1-1-2-2-2-1 were the same or allelic. Studies of the Kawvale x Ponca cross resulted in the conclusion that the genes for resistance to race 6 in these two varieties are different. The postulation was made that Kawvale and Knox differed in the factors which controlled their resistance to race 11; however, Knox and Todd appeared to possess genes in common or at the same loci for resistance to this race. Results were inconclusive concerning the allelic relationships of genes for resistance to race 6 for the Kawvale x Rieti and Richelle x Rieti resistant x resistant crosses.

A minor factor for resistance to race 6 in Todd appeared to be broken down when the variety was grown under crowded conditions. The speculation was made that Clarkan may possess a minor factor for resistance to race 6 in common with Todd.

Smut mycelium of both race 6 and 11 was observed to completely invade the embryos of the resistant variety Todd. The embryo-exclusion type of resistance to these two races was not active in this variety.

Excessively high temperatures adversely affected wheat plants grown in flats in the greenhouse, effectively devernizing many of them. Some observations were made on other techniques used in this study.

Microfilm \$2.50; Xerox \$3.00. 57 pages.

# INHERITANCE OF REACTION TO STEM RUST IN CROSSES BETWEEN CERTAIN VULGARE SPRING WHEATS

(L. C. Card No. Mic 60-5175)

Donald Wayne Sunderman, Ph.D.  
University of Minnesota, 1960

Adviser: E. R. Ausemus

The epiphytotics of *Puccinia graminis tritici* in the Hard Red Spring Wheat Region in 1950, 1953 and 1954 were caused primarily by race 15B. Although none of the commercially grown varieties were resistant to this race, such varieties were available and had been used in the breeding program for some time. The present study was undertaken to determine the genetic basis of resistance to races 15B, 11 and 38 and the allelic relationship among the genes carried by the four varieties tested.

F<sub>1</sub>, F<sub>2</sub> and F<sub>3</sub> progenies from diallel crosses of Frontana, Kenya 58, Mayo 54 and Marquis were tested in the seedling stage to stem rust races 15B, 11 and 38 at a greenhouse temperature of 70°F. Adult plants were tested in a field rust nursery in which the spreaders were inoculated with stem rust race 15B, however, other races may have been present.

Seedling reaction to race 15B appeared to be conditioned by four factors, A from Frontana, D and E from Kenya 58 and D, E and G from Mayo 54. A and D acted as additive or partially dominant genes and governed an intermediate reaction. Heterozygotes for either of these genes were occasionally recorded as susceptible. E acted as a recessive and governed a higher type of resistance than either D or A. G had only a slight direct effect on reaction to race 15B, but modified the reaction governed by D. Homozygotes for A or D were more resistant than heterozygotes and plants with both genes were more resistant than those with only one. The two genes were also effective in raising the level of resistance governed by gene E.

Seedling reaction to race 11 was controlled by five genes, A, B, D, E, and F, three of which were responsible for governing reactions to race 15B. Gene B was present in Frontana and F in Mayo 54. Gene E was found to be dominant, A, D, and F additive or partially dominant and B recessive in conditioning resistance, moderate resistance or moderate susceptibility to race 11. A, B, and D acted as modifiers of E. A and F were complementary or additive in action.

Seedling reaction to race 38 appeared to be conditioned by genes A, B, C, D, and E. A, B, and D were partially dominant or additive and C was partially dominant or dominant for the more resistant reactions. All of them appeared to act as modifiers of the E gene which was dominant for resistance. The C gene was from Marquis.

There were definite associations between the seedling reaction to each race with the reactions to the other two. The A, D, and E genes appeared to govern rust reactions to all races, whereas gene B governed reactions to races 11 and 38 only. Gene E acted as a dominant for resistance to races 11 and 38 and as a recessive for resistance to race 15B. The C gene from Marquis appeared to be closely linked in repulsion with the D gene.

Field resistance was associated with seedling resistance to race 15B and because some of the same genes control seedling resistance to races 11 and 38, it was probably associated with seedling resistance to them. High field

resistance appeared to be dependent upon the genes for seedling resistance to race 15B and one or more additional pairs, as susceptible plants were found in F<sub>3</sub> lines breeding true for high resistance in the seedling stage. Additional evidence supporting this hypothesis was shown by Kenya 58 which, though highly resistant to all races in the seedling stage, had between 20 and 50 percent of rust in the field.

Microfilm \$2.50; Xerox \$7.60. 163 pages.

## AGRICULTURE, PLANT PATHOLOGY

### CHEMICAL CONTROL OF SPOILAGE OF DATES

(L. C. Card No. Mic 60-4579)

A. Razak Almandil, Ph.D.  
Utah State University, 1960

Major Professor: Dr. Orson S. Cannon

A study was made of the possibilities of control of date spoilage by means of antibiotics and chemical fungicides together with conditions of storage temperature as well as the fruit before it is harvested from the tree.

The organisms responsible for deterioration of dates were isolated and studied. Four organisms were found to be most active in date spoilage. They were: Aspergillus niger, Penicillium, Rhizopus and yeast organisms. The side spot decay, caused by Alternaria, Fusarium and Helminthosporium organisms, is mostly confined to the late Khalal and entire Rutab stages.

The action of the antibiotics and fungicide chemicals on these organisms on agar plates was studied. It has been found that Captan and Mycostatin were the most effective inhibitors of the organisms under the test.

Stage of ripening of the fruit was found to effect susceptibility to spoilage. The fruits in Rutab stage are more susceptible to spoilage organism than Khalal and Tamar stages, while Kimri stage was most resistant to causal organisms. The spoilage appears as the calyx-end rot and, if the fruit is wounded, side spot lesions are developed.

The use of antibiotics and fungicides both have significant possibilities in reducing spoilage rate on Khadrawy dates stored at different temperatures and on the tree. The effect of time on the storage of the date fruit (Rutab stage) inoculated with heavy spore suspensions was studied. Captan at 500 ppm was found to inhibit the action of the fungus completely for about 15 days at room temperature. Even after one month at room temperature, 75 percent of the fruit was free from spoilage. Mycostatin gave good results but was less effective than Captan. Dowicide A and Filipin were without effect in preventing the action of the fungi.

Low temperatures help to retain good quality. Temperatures of 40 to 45° F retarded the development of the spoilage organisms. After 25 days at that temperature, there was no sign of spoilage with untreated fruit (Rutab stage) while Captan and Mycostatin gave protection for 90 days.

The rainfall during the fruit-ripening season is one of

the most important environmental factors in the development of date fruit spoilage.

The tendency of the fruit to become infected by the spoilage organisms was also studied. It was found that there was less spoilage in the center of small well-aerated bunches than in the larger ones and that the fruit ripened earlier in small bunches, probably because more surface was exposed to sunlight.

The fruit was treated with materials at various stages of development. Captan and Mycostatin gave the best results in reducing such symptoms as calyx-end rot and side spot lesion.

A variation was observed in the amount of spoilage of dates at the Tamar stage in storage at different temperatures due to fungus and the effect of fungicides. The results showed that Captan treatment keeps the fruit for long periods of time even at higher temperatures which are favorable for organism development. Temperatures of 5 to 10° C. were superior for all lots of dates, and the fruit was kept for long periods in good condition.

With the results of this investigation it will be possible to reduce the losses of the date in Iraq, not only in the packing and storage process but also in protecting the fruit against the action of the decay organisms before it is harvested from trees.

Microfilm \$2.50; Xerox \$4.00. 74 pages.

### PATHOGENIC CAPABILITIES OF THE WHEAT STEM RUST FUNGUS PUCCINIA GRAMINIS TRITICI IN CERTAIN RUST RESISTANT AND TOLERANT VARIETIES OF WHEAT

(L. C. Card No. Mic 60-5618)

Bimala Pada Chakravarti, Ph.D.  
University of Minnesota, 1960

Adviser: Helen Hart

These investigations were concerned with the characteristic behavior patterns and with the aggressiveness of the wheat stem rust fungus, Puccinia graminis Pers. var. tritici (Erikss. & E. Henn.) Shear, Ball, Jacks. & Stakman, and with the differential infectibility and the tolerance to rust attack possessed by some of the new wheat varieties.

Attempts were made to eliminate certain steps and characteristic morphologic conformations that the fungus normally goes through during the infection of the cereal hosts. The germination process itself is the most independent portion of this part of the fungus development and takes place equally well on various biological membranes or physical substrates if moisture and temperature are appropriate. The tendency to form an appressorium, which may be an inherent character of the fungus, persisted even when urediospores were experimentally placed beneath the epidermis of a cereal leaf and in direct contact with the mesophyll cells of the host.

Attempts were made to alter the aggressiveness of this fungus pathogen by various micromanipulations such as transferring small pieces of host tissue with developing fungus mycelium to another host plant. This transfer of the fungus in the midst of its parasitic development from a congenial host to a non-congenial host, or vice versa, or



from a host of one taxonomic category to a host of an entirely different category, did not alter the potential aggressiveness of the fungus. The fungus was capable of some more or less independent mycelial development within restricted spaces of the leaves where relative humidity was high, but as soon as hyphal cells of the fungus came in contact with cells of the transplant host, the intimate localized relationship of the 2 organisms was evident. The aggressiveness of the fungus was determined by the protoplasmic compatibility of these 2 protoplasts, that of the fungus and that of the transplant host. At least some fungus cells could withstand the physical destruction of host cell tissue organization and resume growth into a new transplant host; and some fungus cells could remain alive for 20 days in a highly resistant host and then resume growth into a new transplant host. On the other hand, fungus hyphal cells could be killed by an appropriate treatment with the fungicide Parzate.

Certain new wheats appear to withstand damages from stem rust attack in nature in spite of the fact that they have no marked resistance to the physiologic races of stem rust prevalent in recent years. Some of these new wheats were compared with the variety Carleton, a wheat very susceptible to stem rust race 15B and frequently damaged in the field. A differential infectibility exists, so that initial infection from calibrated quantities of inoculum was higher on Carleton than on the newer wheats. Secondary infections also developed more rapidly on Carleton than on the other wheats when the progressive development of rust was observed on each variety during three growing seasons. Attempts to regulate the development of rust in different plots so that rust attacks of low, medium, and high severity might be achieved on each variety were only partially successful. At the end of each season, yields from plants having different severities of stem rust were compared with yields from plants of the same variety kept rust-free by chemical sprays. Yields of Langdon, Sentry, and Lee wheats were considerably better than yields of Carleton when stem rust attack was severe. These three wheats may be termed rust-tolerant varieties.

Microfilm \$2.50; Xerox \$6.60. 137 pages.

#### STUDIES OF *ALTERNARIA* SPP. PATHOGENIC ON CRUCIFERAE

(L. C. Card No. Mic 60-5130)

Winit Changsri, Ph.D.  
The University of Florida, 1960

Three pathogens, *Alternaria brassicicola* (Schw.) Wilt., *A. brassicae* (Berk.) Sacc., and *A. raphani* Groves and Skolko cause leaf-spot diseases on crucifers. The first two pathogens cause considerable losses of crops in Florida whereas the latter has not been found. Fifty-five isolates of the pathogens and thirteen varieties of cruciferous plants were included in this study. The lesions on leaves caused by *A. brassicicola* are sooty black, velvety and copiously covered with black conidiophores and spores while those caused by *A. brassicae* are gray, dense and sparsely covered with brown conidiophores and spores. The lesions caused by *A. raphani* are small with raised margins and are surrounded by a yellow translucent halo.

On hosts the spores of *A. brassicicola* ranged from 14.7-86.4  $\mu$  x 8.2-19.6  $\mu$ , mostly 5-8 transverse septa, beakless and forming in long chains. The spores of *A. brassicae* ranged from 86.4-252.6  $\mu$  x 14.7-32.6  $\mu$ , mostly 10-11 transverse septa, long beaked, forming mostly singly. The spores of *A. raphani* ranged from 40.7-141.8  $\mu$  x 9.8-29.3  $\mu$ , mostly 6-9 transverse septa, short beaked, forming in short chains. *Alternaria brassicicola* grows and sporulates well on a wide range of agar media. The growth and sporulation of *A. brassicae* are slightly poorer. *Alternaria raphani* grows well in culture but sporulation is rather poor. Spores of *A. raphani* are produced plentifully in most cruciferous leaf decoction agar media and chlamydospores are produced abundantly. The density of the thallus and sporulation decreased as the amount of leaf decoction per liter was decreased from 400 to 6.5 grams. The optimum temperatures for growth in culture of *A. brassicicola*, *A. brassicae* and *A. raphani* are 24 to 28°C, 20 to 24°C and 24 to 28°C while the optimum hydrogen-ion concentrations are pH 6.0 to 8.0, pH 7.1 to 8.0 and pH 7.1 to 8.0 respectively. Zonation formation in culture of *A. brassicicola* is effected by light. Three minutes of light exposure or six hours of darkness alternating from the original source of light is required to induce zonation.

Pure cultures of these fungi individually mixed with steam sterilized soil and then planted resulted in severe infection as pre-emergence and post-emergence damping-off. Inoculations with them produced severe seedling disease and the severity became less important as the plants matured. Cross inoculations of the isolates of *A. brassicicola* and *A. brassicae* on the thirteen cruciferous hosts showed susceptibility to infection.

The amino acids contained in *A. brassicicola* and *A. brassicae* extracts are comparable but slightly different from those of *A. raphani* extract. This similarity of amino acids in the first two pathogen extracts is correlated with the severe to moderate susceptibility of the varieties of crucifers and the difference of amino acids contained in *A. raphani* extract may have accounted for the severe susceptibility only on radish. One amino acid at Rf 0.66 of *A. raphani* extract corresponds to that of the radish extract at about the same level.

Direct penetrations of germ tubes of germinated spores of *A. brassicicola* and *A. raphani* were observed 36 hours after inoculation whereas only stomatal penetration was found on *A. brassicae* 60 hours after inoculation.

Microfilm \$2.50; Xerox \$7.80. 169 pages.

#### THE ROLE OF THE HOST PLANT IN POPULATION CHANGES OF *PRATYLENCHUS* SPP.

(L. C. Card No. Mic 60-6461)

James Stafford Dolliver, Ph.D.  
Cornell University, 1960

The physiological status of the host plant can affect the numbers of nematodes within its roots. *Pisum sativum* L. var. Wando plants were given treatments that influenced plant growth, after being infested with a population of *Pratylenchus* spp., principally characterized

as *P. penetrans*. After 5 weeks, nematode numbers in each pea root system were determined. They were found to be limited by treatments causing severe restriction of root growth (defoliation, scalding of the stem). However, treatments causing moderate restriction of plant growth resulted in higher nematode numbers per root system than were present on untreated plants. On peas grown in sand with tap water, nematode numbers were double that on comparable plants given nutrients. Greenhouse-grown plants from which pods were removed had larger root systems and fewer nematodes than did check plants. Under controlled temperature and light conditions, fewest nematodes were found where plant growth was best.

Optimum emergence of these nematodes from *Dactylis glomerata* L. roots into water took place at 24°C. This emergence was inhibited by hot water treatments before incubation, as well as dilute salt solutions, and reduction of atmospheric oxygen concentration during incubation. In all cases at least partial recovery by the nematodes from the effects of adverse environment occurred after the roots were placed in water at 24°C under a normal atmosphere.

Microfilm \$2.50; Xerox \$6.00. 125 pages.

# STUDIES ON THE PROPERTIES OF BROME MOSAIC VIRUS AND ITS RELATED ANTIGENS

(L. C. Card No. Mic 60-5574)

Richard Ian Hamilton, Ph.D.  
The University of Nebraska, 1960

Adviser: Myron K. Brakke

Studies in the area of host-virus relationships in plant virology have recently demonstrated the presence of anomalous antigens related to the infectious particle in the extracts of virus-infected plants. On the basis of these findings, several investigators have concluded that the multiplication of the infectious particle in the host proceeds in a sequential manner and that these anomalous particles may represent stages in its development. While the results are encouraging in that they permit some insight into an obviously complex relationship, they are subject to the criticism that too little attention has been paid to the factors which affect the stability of the virus used in the study, whether stability is measured by changes in infectivity or by changes in the integrity of the virus particle. The possibility exists, therefore, that some of these virus-related particles may represent *in vivo* or *in vitro* degradation products of the virus.

The fact that crude juice of brome mosaic virus (BMV)-infected barley and corn plants yielded several antigen:antibody precipitation lines in the Ouchterlony serological test suggested that this virus might be used in studies on the stages of virus multiplication. However, when it was subsequently demonstrated that a monodisperse suspension of virus particles obtained by density-gradient centrifugation also showed several precipitation lines, it appeared that BMV might be undergoing some modification in particle integrity under the conditions of a serological test used to determine the degree of homogeneity of an antigen preparation.

Slowly sedimenting particles, serologically related to BMV, were detected after density-gradient centrifugation at pH 7.0 and 8.0 of crude sap from BMV-infected plants and of BMV previously purified by density-gradient centrifugation, indicating that the virus dissociated during the centrifugation. Two antigens, isolated by density-gradient centrifugation, were concentrated by high-speed centrifugation and analyzed by the Ouchterlony technique. Each antigen formed two precipitation lines identical to those formed by purified virus.

Evidence obtained from this study suggests that purified BMV is unstable under mild conditions. The stability of crude and purified virus preparations decreased as pH was increased from pH 5.0 to 8.0, whether stability was measured by loss of infectivity or by the increase in concentration of breakdown products. Materials in extracts of barley stabilized the virus. The stabilization could not be detected at pH 5.0 but it became increasingly greater as pH was increased from pH 6.0 to 8.0. Purified virus dissociated into subunits of uniform size. These subunits, antigens 1 and 2, were non-infectious and are apparently nucleoproteins.

No evidence was obtained to suggest that the antigens which dissociated from the virus during density-gradient centrifugation were present *in vivo*; it is suggested on the basis of immunoelectrophoretic analyses of crude sap and purified virus that the virus dissociated in the agar during the Ouchterlony test to produce the antigens. The results are discussed in relation to the use of gel-diffusion methods to determine the homogeneity of virus preparations.

Microfilm \$2.50; Xerox \$4.80. 93 pages.

# THE SOOTY BLOTCH AND FLY SPECK DISEASES OF APPLE WITH EMPHASIS ON VARIATION WITHIN *GLOEODES* *POMIGENA* (SCHW.) COLBY

(L. C. Card No. Mic 60-5438)

Kenneth Dyer Hickey, Ph.D.  
The Pennsylvania State University, 1960

The sooty blotch disease of apple, caused by the fungus *Gloeodes pomigena* (Schw.) Colby, and the fly speck disease, caused by *Microthyriella rubi* Petr., have been known since the early 1930's. They were not of general importance in Pennsylvania until 1953-1955 when severe outbreaks occurred in orchards sprayed with captan, with thiram, or with low concentrations of glyodin.

Studies were initiated in 1956 and continued through 1959 along these lines: 1) identification of the sooty blotch and fly speck fungi with emphasis on variation within *G. pomigena*; 2) host range; 3) time of apple fruit infection and length of the incubation period; 4) laboratory evaluation of fungicides; and 5) disease control and residual life of fungicides in the orchard.

*G. pomigena* was found to be variable in spore form, septation and color of colonies on agar media. Isolates of this fungus could be placed into four previously-described groups based on the growth pattern produced on apple fruit. All isolates were pathogenic on apple and produced a growth pattern similar to that from which they originated. Isolates showed significant differences in growth under



various nutritional and environmental conditions. It was concluded that variety names could be assigned to some isolates, but that such names would serve no useful purpose and might not be valid because of variation.

Isolates of *G. pomigena* obtained from the stems of the following plants were pathogenic on apple fruits: *Malus pumila* Mill., *Rubus allegheniensis* Porter, *Salix nigra* Marsh., *Platanus occidentalis* L., *Sassafras variifolium* (Salisb.) Ktze., *Vitis cordifolia* Michx., *Pyrus coronaria* L. and *Rhus glabra* L. *M. rubi* was found on *R. allegheniensis*.

The time of apple fruit infection was determined by a bagging technique. The first infections by *G. pomigena* and *M. rubi* occurred before June 21. Infections by both fungi were very numerous on fruit exposed for any half-month period from July 2 through September 15.

The incubation period of *G. pomigena* varied from 4 to 12 days on inoculated fruit in the moist chamber. Inoculations on 45-day-old apples in the field were followed by an incubation period of 20 to 25 days. With natural infection in the field, the incubation period was found to be 28 days on apples 42 days old. Fifteen days was the minimum incubation period observed with *M. rubi*.

Laboratory experiments showed that captan, ferbam and zineb were toxic to *G. pomigena* and *M. rubi*, with zineb less effective than captan or ferbam. Both dodine and American Cyanamid Company's Fungicide No. 8599 gave growth inhibition of *G. pomigena* but dodine was less effective against *M. rubi*. Glyodin and lead arsenate were found to inhibit spore germination of *G. pomigena* on glass slides, but neither chemical prevented growth of *G. pomigena* and *M. rubi* on fungicide-agar media. Lead arsenate was the least effective material used in the laboratory tests.

In spray experiments conducted by the writer and F. H. Lewis, all fungicides tested gave sooty blotch and fly speck control as long as spray applications were repeated at intervals of one-half month or less. After the last spray application, the fungicides could be separated into two groups based on their residual life in the control of sooty blotch and fly speck on apple fruits. Group 1 included captan, thiram and Niacide-Z with a minimum period of 40 days between the last spray and the appearance of disease. Group 2 included zineb, Phaltan, ferbam, glyodin (at 1 quart per 100 gallons of spray) and lead arsenate combined with captan. These fungicides were effective for three or more weeks longer than those in Group 1.

Microfilm \$2.50; Xerox \$6.40. 135 pages.

#### CONCENTRATION AND SPECIFIC INFECTIVITY CHANGES OF ALFALFA MOSAIC VIRUS DURING SYSTEMIC INFECTION IN TOBACCO

(L. C. Card No. Mic 60-6118)

Cedric W. Kuhn, Ph.D.  
Purdue University, 1960

Major Professor: John B. Bancroft

The growth curve of alfalfa mosaic virus, in both systemically-infected tobacco plants and inoculated leaves, rises rapidly after an early nondetectable phase and declines at a similarly rapid rate. Host volume changes

cannot account for the decline. In similar plant material, virus specific infectivity also declines from high, at early harvests, to low values at subsequent harvests. Specific infectivity was based on spectrophotometric, serological, and electrophoretic measurements. Even as virus nucleoprotein concentration is increasing during an early phase after inoculation, the specific infectivity is decreasing. Under various seasonal greenhouse conditions, virus nucleoprotein concentration decreases forty to ninety per cent from a ten to fifteen day harvest (after inoculation) to a thirty to forty day harvest. Virus obtained from a late harvest is only three to forty per cent as infective as that from an early one.

Virus concentration and specific infectivity both decline more rapidly at 80° and 90° F. than at 60° and 70° F. Twenty days after inoculation, virus from plants kept at 90° F. was found to be only six per cent as infective as virus from those kept at 60° F. Specific infectivity of virus in plants maintained at 90° F. was increased three to twelve times by transferring the plants to 60° F. After transfer, new plant growth provided susceptible cells for virus biosynthesis. Excessive plant growth in the greenhouse, two or more weeks after inoculation, also results in an increase in virus concentration and specific infectivity.

Infectivity loss during purification for young infection and old infection virus was not greatly different. The former decreased ninety-five per cent and the latter ninety-one per cent. The effect of host age was studied by inoculating tobacco plants similar in size and age to those from which a late harvest usually would be made. When young and old plants were inoculated with the same inoculum at the same time, the specific infectivity of the two preparations was nearly the same. Sap from healthy tobacco plants decreased the infectivity of purified alfalfa mosaic virus and sap from virus-infected plants. Infectivity decrease was at least twice as much for sap from young plants as sap from old ones. The factor causing the decrease was insignificant at dilutions used in local lesion assays.

Comparison of virus from young and old infections showed no differences in phosphorus content, electrophoretic mobilities (at neutrality), spectrophotometric characteristics, and serological activities (two-fold dilutions). Schlieren patterns obtained by analytical ultracentrifugation were invariant with virus and related noninfectious macromolecules from plants grown under a variety of conditions. The only observed difference between the two virus preparations involved the release of ribonucleic acid by heating. The greatest amount of ribonucleic acid was released from old infection virus at a 5° C. lower temperature than from young infection virus.

Microfilm \$2.50; Xerox \$3.80. 69 pages.

PHYSIOLOGICAL SPECIALIZATION,  
MORPHOLOGICAL AND CULTURAL  
VARIATION IN ISOLATES OF  
HELMINTHOSPORIUM TURCICUM.

(L. C. Card No. Mic 60-4208)

Antonio Eliseo Rodriguez, Ph.D.  
Purdue University, 1960

Major Professor: Arnold J. Ullstrup

Helminthosporium turcicum Pass., the incitant of northern corn leaf blight, is not restricted in its parasitism to corn (Zea mays L.); sorghum (Sorghum vulgare Pers.), sudangrass (Sorghum vulgare var. sudanense Hitch.) and johnsongrass (Sorghum halepense (L.) Pers.) are severely attacked by this fungus, and in some cases heavy losses are sustained when weather conditions are favorable for a rapid development and spread of the disease. Little is known of the physiological specialization of the fungus. The investigations reported here were designed primarily to test pathogenicity of isolates of H. turcicum from sorghum, sudangrass, johnsongrass and corn on a number of differential hosts. A second objective was to cross isolates of the fungus from different hosts and to study the pathogenicity of single-ascospore progenies from such crosses. A third objective was to study the morphological and cultural characteristics of groups of isolates of H. turcicum from single host species and to compare such groups on the basis of these criteria.

Cross-inoculation of 7 single-conidial isolates of H. turcicum from sorghum, 7 from sudangrass, 8 from johnsongrass and 7 from corn represented 3 parasitic races, separated on the basis of their ability to infect these host species and varieties. Isolates from corn induced typical symptoms only on corn, isolates from johnsongrass incited typical symptoms only on this host, whereas isolates from sorghum and sudangrass produced typical symptoms on both hosts. Varieties of sorghum and sudangrass were not equally susceptible to isolates from sorghum and sudangrass.

Inoculation of a set of selected differentials with 15 single-ascospore progenies from the cross (sorghum isolate No. 2 x corn isolate No. 25), 6 from (sorghum isolate No. 61 x corn isolate No. 25), 8 from (johnsongrass isolate No. 15 x corn isolate No. 26), and 3 from (johnsongrass isolate No. 14 x corn isolate No. 25) suggested that pathogenicity is segregated as a unit and usually either one or the other, but not both, of the hosts from which the parental cultures were isolated was attacked. In the infrequent instances where more than a single host was parasitized, virulence of the ascospore progeny appeared to be very attenuated. Re-isolations from each of the two hosts were again weakly pathogenic only on hosts from which the re-isolations were made. It is possible that the initial ascospore was a heterokaryon.

It was impossible to distinguish isolates from the 4 different host species by spore morphology alone.

Comparison of 20 colonies from each of 7 collections of H. turcicum from sorghum, 7 from sudangrass, 7 from corn and 2 from johnsongrass on glucose-casein hydrolysate agar suggested that 3 groups could be formed based on cultural characteristics: a) isolates from corn, b) isolates from johnsongrass and c) isolates from sorghum and sudangrass; each group being characterized by a number

of cultural characteristics. The 3 culturally different groups correspond to the 3 parasitic races determined by cross-inoculation and pathogenicity tests of ascospore progenies from crosses between isolates from different hosts. Isolates from a single lesion from each of sorghum, sudangrass, corn, and johnsongrass were very similar in cultural characteristics, but there was a general tendency for some isolates to vary in rate of growth, kind and color of aerial mycelium and relative sporulation.

Microfilm \$2.50; Xerox \$4.00. 72 pages.

THE EFFECT OF NUTRITION, pH AND  
NEMATODES ON DAMPING-OFF DISEASE  
OF PEA, TOMATO AND CUCUMBER.

(L. C. Card No. Mic 60-5459)

Mustafa Quasim Sayed, Ph.D.  
The Pennsylvania State University, 1960

The purpose of the investigation was to study (a) the pathogenicity of three Pythium species and of Rhizoctonia solani to pea, tomato and cucumber; and (b) the effect of nutrition, pH and nematodes on damping-off disease development.

The pathogenicity experiments were carried out in white silica sand in the greenhouse. Inoculum was uniformly distributed throughout the surface layer of the substrate. Data were taken three weeks from planting time. Results indicated that whereas seed-rotting and pre-emergence damping-off were associated with P. ultimum and P. debaryanum, post-emergence damping-off was prevalent with P. irregulare and R. solani. P. ultimum and R. solani were most pathogenic to pea and cucumber; P. debaryanum was most pathogenic to tomato.

Nine levels of nutrient solutions of which three were balanced and six were unbalanced had been tested for their influence on damping-off disease development incited by P. ultimum and by R. solani. This test was designed in a manner similar to the pathogenicity test and was carried out in an air-conditioned greenhouse in which a day-temperature of 24° C. and a night-temperature of 18.5° C. were maintained. All solutions were adjusted to pH 5.6 and were supplied whenever needed. As the concentration of salts in the balanced solutions was increased, there was always a decrease in disease severity in pea and cucumber and an increase in disease severity in tomato. When unbalanced nutrients were supplied, disease indices of pea and cucumber were significantly less in the high nitrogen and the high phosphorus than in the low nitrogen and the low phosphorus. Tomato seedlings gave an opposite response to the variations in the concentration of nitrogen and a similar response to that of phosphorus. Variations in the concentration of potassium did not prove effective in modifying disease severity.

The effect of pH was studied in solutions of low and high nitrogen. Disease readings at both levels were high at a pH slightly lower than 7.0 in the P. ultimum experiment and at a pH of 7.0 or slightly higher in the R. solani experiment.

In vitro tests were designed to determine the effect of low and high nitrogen and low and high phosphorus on the growth of both P. ultimum and R. solani. The fungi were



grown in 50 ml. of each nutrient solution in 250 ml. flasks. 1.5 per cent of glucose was added to serve as a carbon source for the organisms. The pH of solutions was adjusted to 5.6 and cultures were incubated for 21 days. High phosphorus favored the growth of both organisms over low phosphorus. High nitrogen greatly increased the growth of *R. solani* over low nitrogen. The effect of pH of low and high nitrogen solutions was also examined *in vitro*. Whereas *P. ultimum* grew best at pH 5.6 and 6.8 *R. solani* grew best at pH 6.8 and 7.8 in both nutrients.

The role of fungi-nematode complex and the effect of low and high nitrogen and phosphorus on disease development were evaluated in two experiments. The first experiment included pots containing *P. ultimum* or *R. solani* and equal proportions of three species of nematodes, *Tylenchorhynchus*, *Hoplolaimus* and *Xiphinema*. A total of 200 nematodes was introduced into the sand four days after inoculation. The check treatments included uninoculated pots and pots containing each parasite alone. Results showed that nematodes at this concentration were not capable of producing typical damping-off. No differences between stands in pots containing both nematodes and fungi and those containing fungi alone were observed. In the second experiment, *Meloidogyne hapla* was the species tested. About three thousand nematode eggs were added. Results indicated that a significant increase in disease indices of pea seedlings occurred in pots containing the combination of *M. hapla* and *R. solani* over those containing *R. solani* alone. A slight increase in disease severity was noted in the cucumber but none in the tomato experiment. Variations in the nitrogen or phosphorus levels did not modify disease severity in the experiment in which nematodes alone were tested. However, disease readings were lower in high phosphorus than in low phosphorus in the fungi-nematode test.

Microfilm \$2.50; Xerox \$4.00. 74 pages.

#### OCCURRENCE, DISTRIBUTION AND POPULATIONS OF PLANT PARASITIC NEMATODES ASSOCIATED WITH FORAGE CROPS IN NEW YORK STATE.

(L. C. Card No. Mic 60-6466)

Calvin Herbert Ward, Ph.D.  
Cornell University, 1960

Premature death of perennial forage crops has been a serious problem in forage production for many years in the Northeast. The effects of soil fertility, soil pH, insects, fungus root rots, harvesting practices, cold injury, and other factors on premature death of forage stands have previously been investigated, but the problem remains largely unsolved.

In an investigation of the possible role of plant parasitic nematodes in forage production in New York, a state-wide survey was conducted. Appropriate survey, sampling, and extraction techniques were developed for such an investigation. A total of 368 soil samples and 550 plant samples were taken throughout the state, in 31 of the agricultural counties, and examined for the presence of nematodes. Soil samples were taken from the root zones of 14 different crop plants. Crops sampled most frequently were

alfalfa, birdsfoot trefoil, red clover, white clover, timothy, and smooth brome grass. Crop, soil type, soil drainage, soil moisture, soil pH, rotation, and crop age were recorded for each soil sample. The frequency of occurrence of the above-named variables associated with the samples taken, when compared with their actual frequencies, showed the survey procedure followed gave a representative sample of the conditions under which forage is grown in New York State.

Data were recorded for 16 different parasitic or possibly parasitic genera of nematodes. The genera occurring most frequently were *Pratylenchus* (in 98 per cent of the samples) and *Paratylenchus* (in 89 per cent); *Helicotylenchus*, *Meloidogyne*, *Tylenchorhynchus*, and *Xiphinema* were each found in about 50 per cent of the soil samples.

Large natural populations of several plant parasitic species found were frequently recovered from soil about the roots of the crops sampled. The ecology and/or natural population levels of these genera of nematodes were found to be variously influenced by one or more environmental factors such as crop species, crop age, soil texture, and soil moisture. *Xiphinema americanum* occurred only in soils of medium texture and good to moderate drainage; however, occurrence of *Pratylenchus* spp. and *Paratylenchus* spp. was not affected by these factors. The occurrence of some plant parasitic nematodes was strongly influenced by the crop plants present in their habitats, whereas others were associated with all sampled crops with equal frequency. In general, crop age beyond the seedling year had little effect on potential population levels of plant parasitic nematodes.

Evidence of the effects of several environmental factors on the distribution, occurrence, and natural population levels of most of the genera of plant parasitic nematodes found is presented.

In greenhouse host range and pathogenicity studies, *Heterodera trifolii* reproduced abundantly on and severely restricted the growth of Ladino clover; red clover and alfalfa were also hosts but to a lesser degree. Alfalfa, red clover, white clover, and birdsfoot trefoil were all found to be good hosts of *Pratylenchus pratensis*, and some detrimental effects on crop growth were observed.

In the field, high populations of some plant parasitic nematodes were often, but not always, associated with severe root rot and poor growth of their host drops.

Because of the high frequency of occurrence, wide distribution, large natural populations, and observed detrimental effects on crop growth both under natural conditions and in the greenhouse of some major plant parasitic nematodes, it was concluded that plant parasitic and pathogenic nematodes could be a major limiting factor in forage production in New York State.

Microfilm \$2.50; Xerox \$4.40. 81 pages.

# INHERITANCE OF MOSAIC RESISTANCE IN CUCUMBER

(L. C. Card No. Mic 60-5807)

Slearm Larp Wasuwat, Ph.D.  
The University of Wisconsin, 1960

Supervisor: Professor J. C. Walker

The major purpose of this investigation was to seek information regarding the nature of inheritance of resistance in cucumber to the cucumber mosaic virus strain endemic in Wisconsin.

Both the virus and cucumber plant have relatively high optimum temperature. In the greenhouse, there were two environments which gave reliable results for assaying plants for resistance or susceptibility after inoculation. In the first case, the air temperature was kept at 26 to 28°C. Plants were inoculated on cotyledons at the first true leaf stage. In this case, it took about two weeks after sowing of seeds for the transplanted plants to be ready to inoculate. Final evaluation was made at about three weeks after inoculation. The second environment was the air temperature of 20°C. Seedlings were inoculated on cotyledons at the third true leaf stage. About three weeks after sowing the seeds, the transplanted plants were ready to inoculate and final evaluation was made about three

weeks after inoculation. In the field, it was necessary to evaluate disease development three to four times during the growing season.

In field tests, resistance was completely dominant in F<sub>1</sub> plants. In greenhouse tests, such plants when inoculated were intermediate between resistant and susceptible parents in disease expression during early stages of disease development but after the first shock phase symptoms for the most part disappeared in resistant plants and they approached those of the resistant parent in symptoms and growth.

The resistant character in American varieties was shown to be monogenic on the basis of the segregation in F<sub>2</sub>, F<sub>3</sub>, and F<sub>1</sub> X susceptible backcross progenies. The original resistant variety, Chinese Long, was freer from symptoms in field and greenhouse than American resistant varieties derived from it. However, Chinese Long was shown to have the same single resistant gene pair as American varieties. The Chinese variety appeared to contain modifier genes, additive in effect, which accounted for the higher degree of resistance. These genes appeared to be responsible for variation in symptom expression in segregating progenies under relatively cool temperature. They seem to have been dispersed and to a large extent eliminated during the process of hybridization in which the American resistant varieties used in Wisconsin were developed. Microfilm \$2.50; Xerox \$3.80. 69 pages.

## ANATOMY

# SURVIVAL OF DOGS FOLLOWING SECTION OF CAROTID AND VERTEBRAL ARTERIES

(L. C. Card No. Mic 60-5305)

Donald Fairbairn MacDougal Bunce, II, Ph.D.  
University of Illinois,  
Chicago Professional Colleges, 1960

Both common carotid and both vertebral arteries were doubly ligated and sectioned simultaneously in seven dogs, and some acute and chronic effects observed. No significant change in heart rate, temperature or eyegrounds were noted, but all dogs exhibited marked emaciation, hair loss and edema. Six of the dogs survived for from four to seven months, while the seventh remains alive more than eight months following operation. In a second series of seven "control" dogs, two had only the common carotid arteries cut, two had both vertebral arteries severed at their origin from the subclavian artery, two had both vertebral and both internal carotid arteries sectioned, and one had the right vertebral and both common carotid arteries severed. None of the effects observed in dogs of the first group were seen, and it is concluded that patency of even one of the four major vessels supplying the head is adequate to prevent these changes.

In order to determine the routes by which blood reaches the brain following the quadruple ligature, the normal and collateral arterial patterns were studied by

dissection, injection corrosion preparations and radiography, and the results described. Since the only remaining known arterial supply to the brain is through the anterior spinal artery, it may tentatively be concluded that this vessel alone is capable of transporting sufficient blood to the brain to sustain life immediately following section of the common carotid and vertebral arteries. Other collateral pathways become more fully developed later.

Microfilm \$2.50; Xerox \$4.80. 91 pages.

# THE JUXTAGLOMERULAR APPARATUS IN THE MOUSE AND ITS RESPONSE TO ESTROGENS

(L. C. Card No. Mic 60-5307)

Margaret Wilkins DuBois, Ph.D.  
University of Illinois,  
Chicago Professional Colleges, 1960

Observations were made on the juxtaglomerular apparatus in 63 mature male and female mice. Intravital staining with neutral red, as well as routinely fixed and stained material, was used to demonstrate the granular cells of the renal afferent arteriole. In females, the JGA shows a cyclic variation in granular density. An increase in granulation and hypertrophy of the juxtaglomerular



apparatus was noted at estrus in intact animals and in castrate animals after estrogen treatment. To determine the estrogen administration-time relationship, a single subcutaneous injection of 0.2 gamma of estrogen (Ovocycin Dipropionate - Ciba) was given to ovariectomized animals. Observations were made at intervals during the first 48 hours after estrogen administration. No measurable change in granular density was noted prior to 18 hours. The juxtaglomerular apparatus showed maximal hypertrophy and hypergranulation 24 hours following estrogen treatment. No further increase was observed in the subsequent 24 hours or in animals observed for longer periods. To determine if hyperplasia was a factor in these estrogen-induced changes, a single subcutaneous injection of estrogen was given to ovariectomized animals. Nine and one-half hours before sacrifice, each animal received a single subcutaneous injection of colchicine. Colchicine-arrested mitotic figures were found in the cells of the juxtaglomerular apparatus. This was indicative that hyperplasia of the JGA cells contributed to the changes described.

In a group of male mice, ligatures were placed on the renal vessels. The kidneys were then removed with the ligated vessels attached. The tissues were fixed in formol-saline and stained by Crossmon's method for red blood cells. No significant correlation between regional variations in granular concentration and regional variations in intra-renal blood flow was found. However, the distribution pattern of the red blood cells suggested a possible intermittency of glomerular blood flow.

These observations indicate that the development of hypertrophy and hypergranulation of the JGA after estrogen treatment follows a definite time sequence. Hyperplasia is a factor in these estrogen-induced changes. The observed variations in intra-renal blood flow do not explain the regional variations in juxtaglomerular granulation. Functional correlates to these morphological observations depend upon further experimental work.

Microfilm \$2.50; Xerox \$3.80. 67 pages.

**ELECTRON AND LIGHT MICROSCOPE  
STUDIES OF THE DEVELOPING  
TELENCEPHALIC CHOROID PLEXUS IN  
NORMAL AND EXPERIMENTALLY  
INDUCED HYDROCEPHALIC RABBITS**

(L. C. Card No. Mic 60-5116)

Virginia Mary Tennyson, Ph.D.  
Columbia University, 1960

There is a large body of evidence from clinical and physiological studies which suggests that the adult choroid plexus is actively engaged in the formation of at least a portion of the cerebrospinal fluid. The presence of complex cell surface elaborations, large numbers of mitochondria and pinocytosis vesicles in these cells may represent morphological evidence of fluid transport activity. There is evidence, however, that the blood-cerebrospinal fluid barrier and the composition of the cerebrospinal fluid changes during development. In an attempt to define more clearly the morphological basis for the formation of the cerebrospinal fluid, the fetal and newborn choroid

plexus was examined to determine whether they possessed a different fine structure from the adult. In addition, hydrocephalus, induced by vitamin A deficiency was studied. It has been hypothesized that this type of hydrocephalus is due to an oversecretion by the choroid plexus. The plexuses of hydrocephalic rabbits were therefore, examined in order to determine if hyperfunction can be correlated with changes in fine structure.

During the stage when the blood-cerebrospinal fluid barrier is developing its functional maturity, the morphology of the choroid plexus changes extensively. The simple glycogen-containing fetal cells with their irregular nuclei and few centrally located organelles develop by the third post-natal week into mature, highly complex cells with elaborated membranes and numerous mitochondria. A sequence in the formation and absorption of lipid droplets was observed involving the participation of glycogen, endoplasmic reticulum, mitochondria, and the Golgi complex.

Histochemical stains on adjacent thick sections were studied in order to identify the glycogen, lipid and ribonucleic acid in the thin sections. The weakly positive PAS staining basement membranes of both the blood vessels and the epithelial cells in the fetus become thicker, more fibrillar, and strongly PAS positive in the adult. Thus maturation changes take place at both levels of the blood-cerebrospinal fluid barrier, i.e. in the vascular component, and in the epithelial cells.

In contrast to the complex adult epithelial cells, the simple cell membranes and few mitochondria in the fetal and newborn cells suggest a lower level of fluid transport activity. The function of reabsorption, as evidenced by the uptake of thorium dioxide particles from the cerebrospinal fluid is present at all ages in the normal rabbit. The choroid plexus may, therefore, have a dual role: (1) the absorption of certain substances from the ventricular fluid, a function present at all ages; and (2) the secretion of a specialized cerebrospinal fluid, a function which matures after birth.

The condition of vitamin A deficiency induced hydrocephalus in rabbits in which there is no primary obstruction to the ventricular system as reported by Millen and Woollam (1956), has been confirmed in this investigation. The dural sinuses in the newborn rabbit are lined only by a thin layer of endothelium. Thus it is unlikely that there is a defect of absorption at this site.

Certain morphological changes, such as nuclear irregularities, the clumping of nuclear material, and a different disposition of various cell organelles are found in the choroid plexuses of severely hydrocephalic newborn rabbits. Although the abundance of mitochondria in the epithelial cells of these hydrocephalic rabbits suggests a high degree of metabolic activity, the cell membranes are no more complex than normal. The uptake of thorium dioxide particles from the cerebrospinal fluid is greatly decreased compared to the normal rabbit. Some of these morphological and functional changes may represent secondary effects of pressure and anoxia which cannot, as yet, be separated from those due solely to a vitamin A deficiency.

Microfilm \$3.00; Xerox \$10.60. 232 pages.

AN OSCILLOGRAPHIC STUDY OF  
AFFERENT CONNECTIONS TO THE  
HIPPOCAMPUS IN THE CAT  
*FELIS DOMESTICUS*

(L. C. Card No. Mic 60-5704)

John Stoddard Way, Ph.D.  
State University of Iowa, 1960

Co-Chairmen: Associate Professor Max D. Wheatley  
Professor W. R. Ingram

In a series of approximately fifty-five acute experiments on cats employing a technique of evoked potentials, responses were recorded from the hippocampus by stimulating in different parts of the brain. The areas and structures stimulated include the olfactory bulb, olfactory tubercle, prepiriform and piriform cortex, amygdala, septal and hypothalamic areas, thalamus, and the midbrain. The basal ganglia, preoptic area, and certain thalamic nuclei were less effective than the so-called olfactory areas in eliciting responses from the hippocampus when stimulated.

Responses of about fifty msec. latency were recorded from the dorsal hippocampus when stimulating the olfactory bulb. Ventral hippocampal latencies were shorter than those seen from the dorsal hippocampus, and those from the hippocampal gyrus were shorter than from the ventral hippocampus. Responses with latencies varying from eighteen to thirty-five msec. were recorded from stimulating in the amygdala and from ten to eighty msec. from

stimulating in the area of the olfactory tubercle. Latencies of the order of thirty-five msec. were most commonly seen from this area. Responses of complex form and short (five msec.) initial latency were frequently recorded from the septal area. Stimulation in the nucleus posterior lateralis and the boundary between the dorso-medial and lateral habenular nuclei also elicited responses of very short latency and complex wave form. The medial and lateral geniculate bodies and superior colliculus when stimulated were not effective in evoking hippocampal responses.

Septal lesions attempting to destroy the fornix, in addition to mechanical severance of the fornix, did not block hippocampal responses elicited as a result of stimulating in the olfactory areas of the brain. However, complete transverse incisions of the ventral aspect of the temporal lobe medial to the rhinal fissure and posterior to the point of stimulation did abolish responses from both the dorsal and ventral hippocampus. Based upon these data and coupled with the data of other workers, it is concluded that impulses to the hippocampus may take one of two routes, depending upon their origin. (1) From the septal, hypothalamic, thalamic, and midbrain areas it appears that the fornix system may conduct to the hippocampus. (2) From the olfactory bulb, olfactory tubercle, prepiriform and piriform cortex, and amygdala, conduction appears to be via the piriform lobe, hippocampal gyrus, and entorhinal area to the hippocampus.

Microfilm \$2.50; Xerox \$6.20. 127 pages.

## ANTHROPOLOGY

DODO OF DASS: A STUDY OF A PAGAN  
RELIGION OF NORTHERN NIGERIA.

(L. C. Card No. Mic 60-5086)

Francis Paine Conant, Ph.D.  
Columbia University, 1960

The dissertation is based on field work carried out in Dass Independent District, Bauchi Province, Northern Nigeria, as a Fellow of The Ford Foundation, from 1957 to 1959. The focus of the study is on the religion of the Barawa mountaineers of Dass, with special reference to the implications this religion has for the technology, the social and political organization, and the structure of Barawa society.

Barawa religion centers on a generalized ancestor figure, often referred to by the Hausa word *dodo*, together with a class of spirits known as *sori* (which appear comparable to the Hausa *iskoki*). The public aspect of Barawa religion centers on *dodo*; the private aspect of the religion involves the manipulation of *sori*. While many features of *dodo* religion may be found among the Jarawa and Bankalawa plainsmen in Dass, those Jarawa concerned with District administration and market activities have adopted Islam and have wholeheartedly accepted the ideals and ways of life of the Muslim Hausa.

In the mountains of Dass, traditional features of Barawa material culture, such as clothing, pottery and carving skills, are closely associated with the practice of *dodo* religion. In addition, only the local language (Baranci) may be spoken during the performance of ritual. *Dodo* is visually impersonated by dancers wearing grass skirts and headpieces, and audibly represented by "*dodo* voice"--a ritual language involving disguise of the voice and the reversal of the ordinary meanings of words.

*Dodo* religion involves a series of conflicting demands on its participants which seriously hamper the stability of economically or politically cooperating groups. By contributing to the dispersal of settlements throughout the mountains, and to the acephalous political and social organization found in these settlements, it appears that *dodo* religion has helped make it impossible for competing societies, especially those on the plains, to assimilate or dominate the Barawa.

A methodology is used in analyzing political and social organization which sets up two "standards" against which functional relationships may be judged between different parts of Barawa society. These parts are kin units, cults, market assemblies, and initiation assemblies. The first of the two standards refers to the way in which members of kin units place their allegiance in the other groups. The significance of this "standard of allegiance" is seen in



terms of the dispersed nature of Barawa society. The second standard refers to the use made of the reservoirs of labor represented by each of the groups. The significance of the "standard of labor alternatives" is seen in the performance of agricultural operations involved in the production of sorghum, the staple crop.

A wide variation in the quality of relationships between kin, cult, market, and initiation groups is noted for the Barawa, and leads to the description of their social structure as being "permissive" of such variations. The hypothesis is advanced that this permissive type structure has been an important factor in the adjustment of their traditional society which the Barawa have made to the introduction and spread of Islam, centralized markets, British administration, cash cropping, Christianity, and modern systems of communication and transport. A related hypothesis is that the more "restrictive" structure of Pagan Jarawa society was unfavorable to an adjustment to similar changes in the environment, with the result that the traditional culture was abandoned, and the ways and ideals of the Muslim Hausa adopted in their stead.

Microfilm \$4.50; Xerox \$17.75. 350 pages.

#### GRAMMATICAL STRUCTURE OF SANTA ANA KERESAN

(L. C. Card No. Mic 60-4938)

Irvine Elwin Davis, Ph.D.  
The University of New Mexico, 1960

This study is a structural analysis of the morphophonemics, morphology and syntax of the Keresan dialect of Santa Ana Pueblo. Morphophonemic processes include vowel reduction, voicing and unvoicing of vowels, vowel assimilation, introduction of a vowel phoneme and loss of glottal stop. These processes operate in conjunction with certain types of verb affixation and are rather limited in the extent of their occurrence.

The word as a linguistic unit is defined in terms of distribution with phonological criteria admitted as supplementary evidence. Three major word classes, verbs, verbal auxiliaries, and uninflected words are identified on the basis of their internal structure.

Of the three major word classes, verbs are the most complex in their structure. Grammatical categories expressed by verb inflection are person of the subject or the subject and object, number of the subject and/or object, tense, mode, voice, aspect and condition. Of these categories, mode and person are obligatorily expressed in non-future verbs by one of a complex set of pronominal affixes. A future tense marker may replace the pronominal affix, in which case the categories of person and mode are not indicated in the verb itself but in a verbal auxiliary. All transitive verbs consist of a stem preceded by either a pronominal prefix or a future tense prefix. The stem may optionally be immediately preceded by a voice prefix and/or followed by one or more suffixes expressing aspect, subject number and condition. Intransitive verbs are of two types. Type A intransitive verbs have a structure comparable to that of transitive verbs except that they do not occur with voice prefixes and they occur with a more limited set of pronominal prefixes. Type B intransitive

verbs occur with the pronominal markers as suffixes rather than as prefixes.

Verb stems are composed of a core together with a thematic adjunct. The thematic adjunct is a single vowel or a complex element composed of one or two vowels in combination with /h/, /ʔ/, /w/ or /y/. Thematic adjuncts are characteristic of specific verbs in most of their inflections but may change, for instance, in the passive voice or may be expanded to indicate dual or plural object of transitive verbs.

Verbal auxiliaries express the person of the subject or the subject and object when, as in the future tense, this is not otherwise indicated. They may also be inflected to indicate number and/or condition.

Uninflected words include noun-like words as well as a variety of other function classes. Such words are often unanalyzable, but may belong to one of a number of limited subclasses based on types of derivational formations.

The analysis of Santa Ana syntax is based on recorded text material consisting of native myths. The text, with the exception of certain types of fragment utterances, is segmented into clauses. Clause structure is analyzed in terms of function slots, e.g., the predicate slot, the subject slot and the object slot. Nine function slots are identified and the types of words or phrases that fill each slot are described. Clause types are analyzed in terms of the sequential arrangement of function slots and a frequency count is made of the various types of clauses occurring in a sample text. The text is composed largely of a series of independent clauses. Certain types of dependent clauses, however, are identified which combine with other clauses in larger syntactic units.

Microfilm \$2.55; Xerox \$8.80. 193 pages.

#### TEOTITLÁN DEL VALLE: A TYPICAL MESOAMERICAN COMMUNITY.

(L. C. Card No. Mic 60-5406)

Robert Bartley Taylor, Ph.D.  
University of Oregon, 1960

Adviser: Homer G. Barnett

Teotitlán del Valle, a town of Zapotec-speaking Indians, is located about 350 miles south of Mexico City. In 1956 and 1957 data on the community were collected as a basis for more specialized studies in the same place, particularly in regard to problems of culture change. The town is within the Mesoamerican culture area, and community studies of several other Mesoamerican places have been made. Thus, it becomes both possible and pertinent to ask whether or not research findings in Teotitlán can be considered typical of Mesoamerica as a whole. For this study, it is proposed that Teotitlán del Valle is, in fact, typical of the communities of its culture area, and the data from Teotitlán are compared with those from other Mesoamerican studies in an attempt to test the hypothesis.

The data on Teotitlán, which comprise the bulk of the report, were collected during a nine and one-half month residence there. Spanish-speaking residents of Teotitlán were questioned directly and engaged in informal conversation concerning personal and community customs.

Besides three regular informants, more than a dozen other acquaintances occasionally provided information. Other data were secured by daily observation of the behavior and artifacts of the people. Published reports were utilized for comparative data on other Mesoamerican communities.

The people of Teotitlán live in adobe houses with tile roofs. The houses are located along streets which are laid out on a grid pattern around a central square.

Most of the men have abandoned the pajama-like shirt and trousers of white cloth in favor of modern, ready-made clothing, but the great majority of the women continue to wear blouses, a wrapped skirt held by a long sash, and a shawl. Ordinarily, only the men wear hats or footgear.

Maize and other crops are grown by plow agriculture. The main foods are maize tortillas and maize gruel, but other items, such as beans, chilies, chickpeas, nopal cactus, bread, chocolate, and meat, are regularly used. Important domesticated animals are cattle, pigs, donkeys, sheep, goats, turkeys, and chickens.

The dominant industry is the weaving of wool serapes, most of which are sold to tourists. The men usually do the weaving, and other members of the family card, spin, and dye. Money is used for nearly all exchanges, most of which take place in the local and regional markets and the local stores.

The three-generation, patrilocal, extended family is prominent, and marriage is either by negotiation and

service or by elopement. Children bear important economic responsibilities, and only a few complete all six years in the local school. At baptism a life-long complex of socioeconomic relationships is established between the child and his godparents and between the godparents and the child's parents. There is a hierarchy of municipal authorities headed by a presidente, who ordinarily wields a great deal of power.

Nominally, all are Roman Catholics, though basically they worship the images of the saints, which are kept on the household altars and in the church; and pre-Conquest attitudes survive. The many religious fiestas are important for their social and recreational functions.

A list of 226 typical Mesoamerican traits was compiled from a characterization of Mesoamerican culture by two authorities on the area, Robert Redfield and Sol Tax. The validity of the list was confirmed by comparing it with the data from five Mesoamerican communities, each representing a different tribalistic group and geographical area. Each community manifests a high proportion of the typical features. When the data from Teotitlán are compared with the list, it is found that 80 per cent of the characteristics are known to be present in Teotitlán. On this basis it is concluded that the hypothesis that Teotitlán del Valle is a typical Mesoamerican community is substantiated.

Microfilm \$4.45; Xerox \$15.55. 345 pages.

## ASTRONOMY

### THREE-COLOR PHOTOMETRY OF THE ZODIACAL LIGHT

(L. C. Card No. Mic 60-4941)

Alan Winston Peterson, Ph.D.  
The University of New Mexico, 1960

The object of this study was to obtain absolute intensity maps of the zodiacal light in three colors from photoelectric recordings of the night sky, and to interpret these in terms of the various theories of the zodiacal light.

A 16-inch Schmidt camera with a photomultiplier tube at its focus scanned a  $45^\circ$  wide band completely across the sky. The intensity information was automatically plotted as a map of the sky in terms of intensity and position. Star intensity readings were used for absolute standards of intensity and color. Coordinate transformations between the equatorial and the ecliptic and horizon systems were accomplished by use of an optical coordinate projector which allowed direct reading of the coordinates.

The separation of the zodiacal light from the "background" radiations was accomplished by assuming that the airglow and the total scattered light are independent of azimuth. The intensity variation along two lines of constant azimuth in the background region were corrected for the zodiacal light and milky way contributions using published values. The airglow and scattered light were not separated and constituted the "background" correction. The correction for atmospheric extinction was evaluated theoretically and contains the contributions due to Rayleigh scattering, ozone absorption, and atmospheric refraction.

The absolute intensities obtained from the 13 fully corrected maps agree well with the average of all published values. No displacement of the light axis against the ecliptic is detected.

A change in the intensity slope along the ecliptic for elongations larger than  $70^\circ$  may yield some information on the particle size in the dust distribution. Rough considerations indicate a particle of about a micron which agrees with the presently accepted value. No significant variation of the color index over the entire zodiacal light cone is found in contrast to published results, and in contrast to a theory of the zodiacal twilight which would require a color variation with ecliptic latitude. The zodiacal light polarization is found to vary from about 11% at an elongation of  $137^\circ$  to about 24% at  $60^\circ$  elongation. A 27 kc atmospheric receiver indirectly monitored solar activity during the observing periods to aid in obtaining observations during periods of high solar activity and to aid in correlating any intensity variations of the zodiacal light with solar activity. Observations were obtained during a magnetic storm and an accompanying faint red aurora. No detectable effect upon the zodiacal light intensity was noted. During the aurora a spectrogram indicated that the red airglow lines were enhanced by a factor of about eight. The presence of the red aurora during the magnetic storm may explain a reported intensity increase and a "color anomaly" attributed to the zodiacal light. One-third of one recording was obtained during a solar flare of importance 2+. No detectable effect was noted.

Microfilm \$2.50; Xerox \$8.80. 192 pages.



## BACTERIOLOGY

### STUDIES ON THE DEVELOPMENT AND UTILITY OF OXIDATIVE ACTIVITIES IN *PEDIOCOCCUS CEREVISIAE*

(L. C. Card No. Mic 60-5428)

Walter Jerome Dobrogosz, Ph.D.  
The Pennsylvania State University, 1960

Studies were conducted on the physiological behavior of a number of strains of *Pediococcus cerevisiae* isolated from fermenting alfalfa silages. Historically, these organisms are regarded as facultatively anaerobic, homofermentative lactic acid bacteria which metabolize carbohydrates via the classic anaerobic reactions of glycolysis. The present investigation showed, however, that these bacteria were capable of developing other physiologically significant reactions related to carbohydrate metabolism. In some cases the development of these diverse reactions was a prerequisite for growth. For example, growth upon glycerol was shown to depend on the development of aerobic reactions. Growth upon this substrate was also directly related to the catalase content of the various cells tested.

Spectrophotometric analyses of cell-free extracts of the best glycerol-oxidizing strain - *Pediococcus cerevisiae* Az-25-5 - gave no evidence for a cytochrome system. This observation, correlated with the important role of catalase during the metabolism of glycerol, suggested that aerobic reactions in this organism are mediated by a flavin-type terminal oxidation system.

Whole-cell preparations of strain Az-25-5 were used for studies on the factors which control development of oxidative activities in this organism, i. e., glucose and glycerol oxidizing activities and catalase activity. Factors such as type of substrate, substrate concentration, pH, oxygen tension and nutritional variation were considered. These studies showed that the development of oxidative activities was an inducible phenomenon stimulated by (1) the presence of oxygen (2) growth on low concentrations of substrate (3) growth upon substrates which require an adaptational response. Glycerol, xylose and lactose were the most effective of the substrates in this connection. On the other hand, the development of oxidative activities was repressed during growth upon substrates which were amenable to early and rapid utilization. These "repressor" substrates included glucose, mannose, fructose and cellobiose.

These results suggested that the inducible formation of oxidative activities in this organism may be required for growth on other substrates besides glycerol. Evidence for this suggestion was found in the fact that an anaerobic atmosphere was inhibitory to adaptive growth upon xylose and lactose. A hypothesis was formulated in an attempt to define the relationship between oxidative activities and adaptive growth. This hypothesis was based on the assumption that growth on xylose or lactose required the synthesis of inducible enzymes which in turn, required the cosynthesis of ribonucleic acid (RNA). It was postulated

that aerobic reactions might facilitate the formation of ribose phosphate in quantities sufficient for RNA cosynthesis. Evidence was presented that anaerobic growth upon xylose and lactose could occur if a source of ribose phosphate such as ribose or arabinose was added to the growth medium. Some indirect evidence was presented which suggested that adaptive growth on xylose or lactose may involve the formation of inducible permease-type enzymes.

Preliminary studies were conducted on adaptive pentose utilization in this organism. The presence of dehydrogenase activities for glucose-6-phosphate and 6-phosphogluconate was demonstrated in cell-free extracts.

Microfilm \$2.50; Xerox \$5.80. 117 pages.

### CHARACTERIZATION OF A NEW NON-CYTOPATHOGENIC SIMIAN HEMADSORPTION VIRUS

(L. C. Card No. Mic 60-6105)

Jerrell B. Emery, Ph.D.  
Purdue University, 1960

Major Professor: Dr. Donald P. Gustafson

A non-cytopathogenic hemadsorbing virus has been isolated from normal monkey kidney tissue cultures. The virus occurs in monkey populations with high and low fluctuations according to the season of the year, and may occur in epizootic form. Passage of simian hemadsorption virus (SHV) into porcine, feline, canine, rat, bovine embryo, or monkey kidney cultures resulted in successful propagation only in bovine embryo and monkey kidney cells.

Isolations were obtained from 13 of 26 lots of monkey kidney cells tested. Five isolates were selected for study and found to be of one serotype. No serological relationships to the cytopathogenic simian viruses, influenza, polio, adenovirus or upper respiratory feline virus groups were shown. However, the simian hemadsorbing viruses were found to be identical serologically to para-influenza 1 virus by neutralization procedures, and the mathematical computations of Archetti and Horsfall. No relationship could be found with para-influenza 3 virus.

Simian hemadsorption virus was found to possess a hemagglutinin for fowl erythrocytes at 4°C., be sensitive to ether treatment, filterable through a Selas 03 filter, and is stable at -70°C. Propagation in the amniotic cavity of eight-day-old embryonating chicken eggs could be shown. Therefore, the virus conforms partially to the requirements of myxoviruses as outlined by Andrewes, Bang, and Burnet. However, the presence of receptors sensitive to RDE of *Vibrio cholerae* filtrate was not determined.

Antibody against the simian virus was demonstrated in

the sera of humans, which showed close correlation to the presence or absence of para-influenza 1 virus antibody.

Further study is necessary in order to elucidate the pathogenicity of this virus for monkeys or humans, and to determine more accurately its role in upper respiratory virus infections.

Microfilm \$2.50; Xerox \$3.00. 42 pages.

#### MAMMALIAN CELLS IN CULTURE FOR HOST CELL-VIRUS RELATIONSHIP STUDIES

(L. C. Card No. Mic 60-5600)

Ronald William Hinz, Ph.D.  
University of Minnesota, 1960

Adviser: Jerome T. Syverton, M.D.

Viruses of both man and animals which possess a natural host specificity can multiply and cause various cytopathogenic effects *in vitro* on cells derived from different species. Restriction of cell types that can be dispersed efficiently by trypsin from tissue hampers *in vitro* study of some viruses, comparison of virus susceptibility of cells *in vivo* and in primary culture, and direct clonal derivation of cell lines from tissue. This abstract describes the *in vitro* susceptibility of various cell types to viruses of both man and animals, the use of collagenase for preparation of primary monolayer cultures of lung, a tissue usually poorly dispersed by trypsin, for study of influenza viruses, and a method for obtaining cells of known tissue element origin.

Porcine kidney (fetal or adult) was dispersed by agitation at 5° C overnight in 0.2% trypsin with Hanks' solution as the diluent. Usable monolayers appeared in 5-7 days when using homologous serum (20%) - YEM medium. Japanese B, and Eastern equine encephalomyelitis, vaccinia, canine hepatitis, canine distemper, and Newcastle's disease viruses propagated to high titer with continued cytopathogenic effect. Western equine and St. Louis encephalomyelitis, flury rabies, Colorado tick fever, and hog cholera viruses propagated to low titer with minimal cytopathogenic effect. Poliomyelitis, ECHO (types T1 through T19), and infectious bronchitis viruses did not propagate.

Human, porcine, and rabbit lung tissues (fetal or adult) were dispersed by agitation at 37° C for 2 hours in 0.01% collagenase in phosphate-lacking diluent, with or without prior trypsin treatment to fragment tissue and to remove erythrocytes. In YEM with 20% homologous serum, collagenase-dispersed cells generated usable monolayer cultures in tubes or bottles within 3-5 days. Both lung and renal medullary tissue, difficult to disperse with trypsin, were reduced efficiently with collagenase to yield excellent primary monolayers, or continuous cultures dispersible by routine trypsin treatment. Human and porcine lung cells appear mesothelial. Human lung cultures suffered minimal cytopathogenic effect of influenza viruses A (Asian, PR-8) or B (Lee), but propagated egg-infectious viruses and yielded hemagglutinin through 15 passages. Swine virus was not infectious for these cells. Porcine lung cultures yielded some egg-infectious A viruses after 15 passages, showed continued cytopathogenic effect of B virus despite loss of egg infectivity, and serially propa-

gated cytopathogenic, egg-infectious swine virus and hemagglutinin to high titer. Hemagglutinin production of A and B viruses declined with passages. Porcine kidney cultures were not affected by A and B viruses, and showed no cytopathogenic effect of swine virus although yielding some hemagglutinin and egg-infectious virus after 15 passages. Rabbit lung cultures, fibroblastic in appearance, were not affected by human or swine influenza viruses.

Porcine epidermis from 70 day old fetuses was removed mechanically totally free of dermis and maintained as organ fragments for periods up to 30 days. Vaccinia and swine pox propagated to high titer in the tissue and cytopathologic effects caused by the agents were not unlike those occurring *in vivo*. Shope papilloma virus showed no evidence of causing proliferative effects. This material of known tissue element origin offers a tool for tumor virus and metabolic studies.

Microfilm \$2.50; Xerox \$5.20. 104 pages.

#### A COMPARISON OF THE MECHANISM OF GLYCEROL OXIDATION IN AEROBICALLY AND ANAEROBICALLY GROWN *STREPTOCOCCUS FAECALIS*

(L. C. Card No. Mic 60-6456)

Nicholas Joseph Jacobs, Ph.D.  
Cornell University, 1960

The enzymes responsible for glycerol oxidation by both aerobically and anaerobically-grown cells of *Streptococcus faecalis* 10C1 were determined. In cell free extracts of anaerobically-grown cells, a diphosphopyridine (DPN)-linked glycerol dehydrogenase was found. The enzyme is not present in extracts of aerobically-grown cells. In these latter extracts a glycerol kinase and a non-DPN-linked  $\alpha$ -glycerophosphate ( $\alpha$ -GP) oxidase were found which are absent from the extracts of anaerobically-grown cells. Extracts of anaerobically grown cells were shown to reduce fumaric acid with either reduced DPN or reduced free flavins. The reduction of free flavins by reduced DPN was observed in extracts of cells grown both aerobically- and anaerobically.

The oxidation of glycerol by whole, resting cells of both aerobically- and an anaerobically-grown *S. faecalis* 10C1 was also studied. The purification and partial resolution of the  $\alpha$ -glycerophosphate oxidase of *S. faecalis* 10C1 is described. The purified enzyme in the presence of gaseous oxygen oxidizes L- $\alpha$ -glycerophosphate, forming hydrogen peroxide and dihydroxyacetone phosphate. Flavin adenine dinucleotide as a prosthetic group is required for maximum activity of the purified enzyme. Riboflavin, flavin mononucleotide, pyridine nucleotides, or cytochrome c, do not function as prosthetic groups of this enzyme. The purified enzyme oxidizes L- $\alpha$ -glycerophosphate but not D-glycerophosphate, glycerol, dihydroxyacetone phosphate, or 1, 2-propanediol phosphate. The enzyme has a  $K_m$  for L- $\alpha$ -glycerophosphate of  $4 \times 10^{-3}$  M and a pH optimum of 5.8.

In addition to oxygen, ferricyanide and 2, 6-dichlorophenolindophenol serve as electron acceptors for the enzyme, whereas methylene blue and cytochrome c are reduced at much slower rates. The purified enzyme is not markedly inhibited by citrate, versene, cyanide,



a, a-dipyridyl, arsenite, 8-hydroxyquinoline, or parachloromercuribenzoate. Azide, acriflavin, and atabrin are inhibitory. The differences and similarities of this a-glycerophosphate oxidizing enzyme and a-glycerophosphate dehydrogenases from other sources, as well as taxonomic importance of all the findings are discussed.

Microfilm \$2.50; Xerox \$4.20. 76 pages.

# GLYCOPROTEINS OF THE EMBRYONATED EGG INFECTED WITH PR8 INFLUENZA A VIRUS

(L. C. Card No. Mic 60-5310)

Nick Karabatsos, Ph.D.  
University of Illinois,  
Chicago Professional Colleges, 1960

Little or no information is available concerning the role and fate of glycoproteins in virus infections of humans or experimental animals. One report of an investigation conducted with cytochemical methods indicated that there is a decrease in the concentration of glycoproteins in mouse lung epithelial cells infected with influenza virus. Studies conducted in humans revealed that virus infection results in irregular levels of circulating glycoproteins. Generally, a depression in the level was noted. Studies of this nature may be of particular value in the biochemical characterization of influenza virus infection. This is especially true if one considers that changes in the carbohydrate constituents of infected host tissue may reflect the synthesis or incorporation of polysaccharide material in the virus particle as well as an intense enzymatic activity of the virus on certain sialic acid-containing constituents. This investigation was initially concerned with the quantitative and qualitative assessment of changes in the proteins of chorio-allantoic membranes and fluids from embryonated eggs infected with influenza virus.

Analysis of extracts of infected and normal membranes was accomplished by column chromatography with the anionic exchanger, diethylaminoethyl (DEAE) cellulose. A single additional component, a hemoglobin-binding glycoprotein, was found in infected membranes and was never detectable in normal membrane extracts. This component was not specific for virus infection, for saline inoculation or needle insertion alone were sufficient to initiate the production of the glycoprotein. The presence of viral infection did not alter the amount or rate of its formation. Although there was no indication of a relation to influenza virus infection, this observation was of basic significance and therefore required further consideration and investigation.

No essential difference was noted in the yields of this component at 6 and 24 hours upon treatment of the membranes with virus infection, saline inoculation, and needle insertion, although the yields obtained by saline treatment were slightly lower. The glycoprotein was detectable as early as one hour post-treatment and it reached a peak value between 24 and 72 hours.

Complement-fixation studies indicated that there was no antigenic relationship between the glycoprotein and influenza virus, although its antigenic relation to normal components of the embryonated egg was considered likely.

The glycoprotein-hemoglobin complex did not affect nor interfere with the ability of the virus to multiply nor did it exert any inhibitory effect on the hemagglutinating activity of influenza virus. The incorporation of the complex into tissue culture medium lacking serum in the presence of human liver cells, resulted in the formation of pigmented fibrils. Similar results were obtained when the complex was incorporated into deficient medium which had been preincubated with the liver cells. The experimental evidence suggested that the presence of the complex was required at all times. It was also necessary that the deficient medium be in contact with the liver cells either simultaneously or prior to the incorporation of the complex. Therefore, it was suggested that the liver cells resulted in an alteration of the medium or in the elaboration or release of a factor which aided the incorporation or polymerization of the complex into fibrils.

Electrophoresis on filter paper and in starch gel indicated that the complex behaved differently from adult or embryonic hemoglobin. No separation of the glycoprotein portion from the hemoglobin portion was observed. The complex appeared similar to the haptoglobin-hemoglobin complexes of several human sera and of the two adult chicken plasma, during electrophoresis on paper, although a slight difference was resolved by electrophoresis in starch gel.

Chemical analysis revealed that the isolated complex was quite dissimilar from human haptoglobin.

The necessity for the inclusion of proper controls in studies of this nature was stressed.

Chemical analysis of CAF and of extracts of membranes from normal and infected eggs revealed that certain pertinent changes occurred during virus infection. An increase in protein-bound polysaccharide and total hexose was noted in infected CAF. The increase in protein-bound polysaccharide may be partially or wholly accounted for by the appearance of the hemoglobin-binding glycoprotein in the infected membranes, some of which is also released into the CAF. Infected CAF also contained a lesser amount of protein-bound sialic acid which was soluble in perchloric acid. This was considered to reflect an increase in free sialic acid due to the enzymatic activity of the virus released into the fluid. A decrease in the ratio of protein-bound hexose to nitrogen was noted in infected membranes. There was an apparent decrease of protein-bound hexosamine, while the protein-bound sialic acid appeared unaltered. An increase in the protein-bound hexose which was soluble in perchloric acid was also apparent. It was found that none of the protein-bound sialic acid in normal membranes was soluble in perchloric acid, while 100% from infected membranes was thus soluble. These results suggested that the cited events were reflective of modifications in certain aspects of glycoprotein metabolism during influenza virus multiplication. It was also believed that these changes were intimately associated with certain phases of influenza virus multiplication, namely, the synthesis or incorporation of viral polysaccharide into the particles, the incorporation of polysaccharide or lipopolysaccharide residues into the virus as haptens, and a marked activity of the influenza virus neuraminidase. In correlation with certain previously reported evidence, the apparent non-alteration of the ratio of protein-bound sialic acid to nitrogen in infected membranes was explained as representing a periodicity of enzymatic destruction and subsequent regeneration of the sialic

acid-containing receptors and inhibitors present in the membranes. Two explanations are possible for the 100% increase of protein-bound sialic acid which is soluble in perchloric acid. The receptors and inhibitors are originally present as aggregates, and disaggregation occurs under the influence of the viral enzymatic activity. Alternatively, influenza virus infection causes a modification in the metabolism of these sialic acid constituents which is oriented to an almost exclusive production of lower molecular weight sialic acid-containing mucoids.

Microfilm \$2.50; Xerox \$6.80. 143 pages.

**SEROLOGICAL AND PASSIVE TRANSFER  
STUDIES ON CELLULAR EXTRACTS  
FROM GUINEA PIGS SENSITIVE  
TO 2,4-DINITROCHLOROBENZENE**

(L. C. Card No. Mic 60-5676)

Keith Royce Long, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor Wayburn S. Jeter

Electrophoretic analysis of leucocytic extracts from sensitive donors which passively conferred cutaneous reactivity to 2,4-dinitrochlorobenzene in normal recipients revealed the presence of a sixth component not present in extracts from normal donors.

Gel diffusion analysis revealed no difference among cellular extracts and serum from normal donors and cellular extracts and serum from sensitive donors. An antigenic relationship exists between leucocytic extracts and serum of both normal and sensitive donors.

Passive transfer of cutaneous reactivity to 2,4-dinitrochlorobenzene by cellular extracts was found to be inhibited by antiserum to cellular extracts and by antiserum to serum from both normal and sensitive animals. Passive transfer of sensitivity to 2,4-dinitrochlorobenzene by intact leucocytes was not inhibited by antiserum to intact leucocytes, antiserum to leucocytic extracts, or antiserum to serum from both normal and sensitive donors.

Animals sensitized with dinitrophenyl-substituted egg albumin gave a typical delayed skin response to topical application of a solution of 1% 2,4-dinitrochlorobenzene in alcohol and to intradermal injection of dinitrophenyl-substituted guinea pig serum. Topical application of dinitrophenyl conjugates of egg albumin and guinea pig serum failed to elicit a skin response in sensitive animals. Anaphylaxis was produced in animals sensitive to 2,4-dinitrochlorobenzene when they were challenged with dinitrophenyl-substituted guinea pig serum.

Gel diffusion analyses using dinitrophenyl conjugates of egg albumin and guinea pig serum as antigen and leucocytic extracts and serum from 2,4-dinitrochlorobenzene-sensitive animals as antibody failed to reveal the presence of antibody. Microfilm \$2.50; Xerox \$3.00. 51 pages.

**FACTORS STIMULATING THE FORMATION  
OF LYSINE DECARBOXYLASE IN  
ESCHERICHIA COLI**

(L. C. Card No. Mic 60-5447)

Andrew Maretzki, Ph.D.  
The Pennsylvania State University, 1960

The pathway of synthesis of a specific enzyme, lysine decarboxylase, was investigated in *Escherichia coli* B. A commercial acid hydrolyzate, called "Hy-Case," was found to exert an effect beneficial to production of this enzyme. The factors responsible for this effect were studied.

Abstraction of methionine, threonine, leucine, proline and tyrosine in turn from a medium containing a mixture of amino acids caused decreases in the enzyme level ranging from 40 to 95 percent of the complete mixture of amino acids. Hence, they must be linked closely with the requirements for the synthesis of lysine decarboxylase.

"Hy-Case" addition to the *E. coli* medium resulted in lysine decarboxylase synthesis which was 40 to 50 percent greater than synthesis manifested by a combination of free amino acids.

The presence of several stimulatory peptides in "Hy-Case" was established by chromatographic detection. A partial purification of the peptides was achieved by means of electrophoretic separation followed by further fractionation on a cellulose column. The influence of the isolated fractions on lysine decarboxylase formation in *E. coli* was determined manometrically.

Two fractions containing peptides stimulated enzyme synthesis when the cells were grown in the presence of the essential free amino acids. One active peptide was investigated and shown to contain at least nine amino acid residues. The other fraction contained a mixture of peptidic components which could not be separated further without extensive loss of the enzymatic activity.

The rate of lysine decarboxylase formation during the logarithmic growth phase of the organism increased in the presence of "Hy-Case." The data obtained suggested that peptides occurring in "Hy-Case" were incorporated directly in the protein moiety of this particular enzyme.

Microfilm \$2.50; Xerox \$3.80. 69 pages.

**COMPARATIVE LYTIC REACTIONS  
OF ENTEROBACTERIACEAE**

(L. C. Card No. Mic 60-6122)

Eric Charles Noller, Ph.D.  
Purdue University, 1960

Major Professor: S. E. Hartsell

With the hope of utilizing lytic reactions as a possible means of differentiating members of the *Enterobacteriaceae*, the lytic response of twenty-three strains of *E. coli*, three other species of *Escherichia*, and species of *Aerobacter*, *Erwinia*, *Klebsiella*, *Paracolobactrum*, *Proteus*, *Providencia*, *Salmonella*, *Serratia* and *Shigella* was compared using the Nakamura technique, lysozyme and EDTA, and two new lytic systems developed in the course of these investigations.



Optimal lysis of gram-negative bacteria by lysozyme, trypsin and butanol (first system) was found at concentrations of 10-40  $\mu\text{g}/\text{ml}$  lysozyme, 5-20  $\mu\text{g}/\text{ml}$  trypsin, and 5% v/v n-butanol at pH 7. Only ethyl acetate could substitute for n-butanol in this system. Other isomers of butanol and shorter-chain alcohols of the homologous aliphatic series were not as effective as n-butanol. The action of n-butanol appears to result from its ability to dissociate the lysozyme substrate-protecting lipoprotein structure of the gram-negative cell wall. Circulin and lysozyme (second system) were most active in lysing *Enterobacteriaceae* at concentrations of 10  $\mu\text{g}/\text{ml}$  and 5  $\mu\text{g}/\text{ml}$ , respectively, at pH 7. Because of its strong surfactant properties, circulin is presumed to dissociate lipoprotein moieties in the cell wall and render lysozyme substrate available for digestion by lysozyme.

The comparative lytic reactions of the *Enterobacteriaceae* cultures indicated that lytic sensitivity of a given culture was peculiar to that culture. No correlation was observed between lytic response and culture species. A quantitative spectrum of lysis was observed between strains of the same species, species of the same genus, and genera of the family. *Aerobacter aerogenes* strains were lysed readily by circulin and lysozyme while *Klebsiella pneumoniae* strains were not. Hence, a rapid method has been developed that distinguishes between these closely related organisms. Aside from the comparative aspects of these studies and the extension of available lytic systems, it has also been established for the first time that species of *Paracolonobacterium*, *Providencia* and *Serratia* are also lysable by lytic methods involving lysozyme.

A comparison was also made between the various pre-treatments and co-treatments of cells that potentiated lysozyme activity. Heat (70° C), acid (pH 3.5) and butanol pre-treatments were found to be almost identical in sensitizing cells to lysis by lysozyme. Cells co-treated with EDTA at pH 8 responded to lysozyme and/or trypsin in a manner similar to butanol co-treated cells. Comparison between hydrogen-ion uptake of treated cells and untreated cells indicated that heat and butanol disorganized the cell surface to an extent that permitted rapid and immediate proton binding by cells, which reaction did not occur with control cells until the pH had been lowered to the vicinity of 3. These data indicate that heat, solvents, low pH, and EDTA are all capable of exposing the muco-complex to lysozyme by dissociating the protective "layers" or "complexes" which render the normal (control) cell refractory to lysozyme action. The extent to which a given cell will lyse in the presence of these lytic systems would appear to be a function of the amount of lysozyme substrate present in the cell wall and of the manner in which it is distributed within the protective lipoprotein wall components.

Microscopic observations during cell lysis indicate that rod-like residual structures ("ghosts") remain after treatment by any of the lytic systems studied. With the exception of those "ghosts" remaining after lysis by systems containing EDTA or trypsin, these residual structures are capable of reversible shrinking and swelling by alternate treatment with acid then alkali and maintain rod morphology during such treatment. Since the lysozyme substrate has been degraded to an extent that would eliminate its role as a shape-conferring component of the cell wall, it appears that some other wall constituent and/or endocel-

lular reticulum is also active in maintaining the normal rod morphology of the gram-negative cell. Since trypsin treatment of these residual structures was found to eliminate the shrinking-swelling effect, it appears that the additional structural component is essentially proteinaceous in nature. Microfilm \$2.50; Xerox \$6.80. 143 pages.

# PHYSICO-CHEMICAL PROPERTIES OF A TOXIC CELLULAR COMPONENT OF GROUP A STREPTOCOCCI

(L. C. Card No. Mic 60-4863)

Bob Sanders Roberson, Ph.D.  
The University of North Carolina, 1960

Supervisor: Dr. John H. Schwab

Schwab and Cromartie (1957, *J. Bacteriol.*, **74**, 673-679) observed that sterile lysates of disrupted group A streptococci are capable of producing chronic, remittent, multinodular lesions of the dermal connective tissue of rabbits, following a single intradermal injection. From these lysates, a homogeneous toxic fraction was isolated which contained the group-specific C polysaccharide (Schwab et al., 1959, *J. Exptl. Med.*, **109**, 43-54).

The purpose of this investigation was to isolate and characterize more precisely the basic unit of toxicity.

To determine the relative importance to activity of non-carbohydrate moieties, partially purified fractions were treated with a variety of proteolytic enzymes, ribonuclease, lipid solvents, and phenol. The stability of toxicity to these procedures provides indirect evidence to relate dermal activity to the polysaccharide. The reduction of activity accompanying limited periodate oxidation provides presumptive evidence for the necessity of the C polysaccharide for induction of the lesion.

In order to relate lesion-producing activity more directly to the polysaccharide of the cell wall, a procedure utilizing sucrose zone centrifugation was introduced which provides an efficient method for collecting cell walls. Cell walls prepared by this method were examined by electron microscopy, and analyzed by moving boundary electrophoresis and immunological techniques. By these criteria, it was concluded that a sufficiently high degree of purity had been achieved so that biological properties could be related to the cell wall.

Although whole cell walls exhibit little lesion-producing capacity, injection of these elements following solubilization by sonic vibration, produces lesions indistinguishable from those induced by the whole cell extracts. It is concluded that the connective tissue toxin is derived from the streptococcal cell wall.

The relative lesion-producing capacities of the cell walls, the isolated C polysaccharide hapten, and fractions of intermediate complexity, indicate that properties of size and configuration profoundly affect toxicity. Determination of the lesion-producing capacities of a series of fractions containing the C polysaccharide, ranging in size and complexity from the cell wall to the 8000 mol wt hapten, illustrates that tissue toxicity is increased by dispersion of the more complex fractions, but reduction beyond a limiting, minimum complex is accompanied by a corresponding

reduction in activity. The limiting complex can be surpassed by sonic vibration, treatment with filtrates of *S. albus* culture or by extraction with formamide. Some chemical and physical properties of the most active preparation from this series are reported.

The observations of Stetson (1956, *J. Bacteriol.*, 104, 921-936) on the endotoxic properties of sonic lysates of streptococcal cells, have been extended to show that the cell wall is the apparent source. Although the pharmacological effects are similar to those produced by gram negative endotoxins, activity of dispersed streptococcal cell walls appears to be more related to a class of colloidal substances of diverse chemical composition, which also display some of these properties in relatively large doses. The endotoxic properties of cell walls seem unrelated to the lesion-producing capacity, which is dependent on the unique chemistry of the streptococcal polysaccharide.

The possible importance of the connective tissue toxin is discussed in relation to the development of the non-suppurative sequelae of group A streptococcal infections.

Microfilm \$2.50; Xerox \$5.20. 104 pages.

#### METABOLIC ACTIVITIES OF AMIDES IN VIRUS-INFECTED CELLS

(L. C. Card No. Mic 60-5579)

Leslie Robert Sabina, Ph.D.  
The University of Nebraska, 1960

Advisers: Carl E. Georgi and George A. Young

Normal metabolic processes of host cells are affected by virus multiplication causing an alteration of the activities of enzymes which might result in the formation of new or altered biochemical pathways. In this respect, the host-virus model selected for study was the bovine kidney cell culture-infectious bovine rhinotracheitis (IBR) virus system.

To date, very few changes in enzyme make-up in animal cells infected with virus have been uncovered. Part I of this dissertation describes amino acid amidase (AAA-ase) activities in normal and infected bovine kidney tissue cultures during the first 6 hours after inoculation with IBR-virus. Leucinamidase showed an accelerated enzymatic activity in IBR-infected cultures and attained a peak activity within 1 hour after infection. Furthermore, leucinamidase was the most active of the AAA-ases tested to respond to viral infection. Tyrosinamidase and glutaminase differed significantly from leucinamidase in the rate of increase in activity under identical conditions. On the other hand, the control cultures demonstrate a more gradual increase in enzyme activity. Asparaginase and glycinamidase activities in primary bovine kidney cultures were found to be low. Both bovine primary and established cell line cultures were susceptible to IBR-virus attack and exhibited similar AAA-ase activities. The AAA-ase activities of the homogenates of infected cells were not affected by the composition of the medium utilized for the growth of cells. Studies in beef cattle inoculated intranasally with low- and high-passaged Cornell strains of IBR-virus showed a simultaneous increase in serum leucinamidase activity and temperature. Cattle inoculated

intramuscularly with a Cutter strain of IBR-virus elicited an immune response but did not show an increased level of serum leucinamidase after inoculation.

Part II describes the comparative aspects of preferential utilization of leucinamide and glutamine-amide nitrogen. Biochemical fractions of cells fed DL-leucinamide-1-C<sup>14</sup>, L-leucinamide-N<sup>15</sup> and L-glutamine-amide-N<sup>15</sup> were compared in normal and IBR-infected bovine kidney primary tissue cultures. L-glutamine-amide-N<sup>15</sup> uptake in the acid-soluble fraction was greater in virus-infected cultures than control cultures. L-leucinamide-N<sup>15</sup> was similarly concentrated as L-glutamine-amide-N<sup>15</sup> at zero time. The incorporation of L-leucinamide-N<sup>15</sup>, however, was essentially the same in both control and virus-infected cultures. In the nucleic acid and protein fractions of control and virus-infected cultures, L-leucinamide-N<sup>15</sup> closely paralleled the incorporation of L-glutamine-amide-N<sup>15</sup>. Comparison of the concentrations of DL-leucinamide-1-C<sup>14</sup> and L-leucinamide-N<sup>15</sup> in different biochemical fractions are reported. The nucleic acid and protein fractions of normal and virus-infected cells show a limited incorporation of C<sup>14</sup>. Progressive incorporation of N<sup>15</sup> was noted in all fractions with the exception of the 18 hour nucleic acid fraction of normal cells. The most obvious interpretation of the data is that L-leucinamide-N<sup>15</sup> was not incorporated intact but rather as labeled ammonia.

The preparation of L-leucinamide-N<sup>15</sup> was effected by treating CBZ-L-leucyl azide with N<sup>15</sup>H<sub>4</sub>NO<sub>3</sub> and its synthesis is described.

Microfilm \$2.50; Xerox \$3.00. 60 pages.

#### A COMPARATIVE SEROLOGIC AND PHYSIOLOGIC STUDY OF PLEUROPNEUMONIA-LIKE ORGANISMS

(L. C. Card No. Mic 60-5258)

Mark E. Tourtellotte, Ph.D.  
The University of Connecticut, 1960

Fifteen strains of pleuropneumonia-like organisms (PPLO) were examined serologically and physiologically, namely; 2 human, H-07 and H-39; 3 bovine, A, B-15, and B-16; 1 caprine; 1 porcine; 1 ovine; 1 saprophytic, Laidlaw B; and 6 avian, A5969, S6, F, C, 621, and pigeon.

All PPLO studied appeared similar morphologically and colonially and grew aerobically and anaerobically with the optimum growth occurring in an atmosphere containing between 1 and 5 per cent oxygen in the presence of small amounts of CO<sub>2</sub>.

Serologically, however, the organisms differed widely and, with the exception of a few strains, did not cross react with each other. Cross reactions were observed only between human H-07 and H-39; caprine and ovine; and avian A5969, F, and S6. Avian 621 antiserum reacted weakly with A5969, F, and S6 antigens. Serology, therefore affords a useful tool for differentiating organisms of this group.

Physiologically, the organisms were divided into a non-fermentative group comprising human H-07, H-39, bovine B-16, and pigeon. The remainder belonged to a fermentative group which utilized glucose, mannose, dextrin, and with some variability, glycogen, starch, maltose, sucrose,



fructose, and galactose. No other sugars were fermented. The end-products of glucose metabolism in broth were lactic, pyruvic, and acetic acids and trace amounts of acetylmethylcarbinol (AMC).

Although carbohydrates produced increased turbidity when added to the basal medium, lactate, acetate, and succinate did not. Results, in growing cultures and manometric studies, suggested that glucose was metabolized slowly by the tricarboxylic acid cycle, if at all.

The accumulation of pyruvate in broth cultures was removed by the addition of diphosphothiamine (DPT), coenzyme A, and  $\alpha$ -lipoic acid. The requirement for DPT and  $\alpha$ -lipoic acid in pyruvate oxidation by cell suspensions was demonstrated in 1 strain (A5969).

Manometric studies of cell suspensions showed that all fermentative strains oxidized glucose and pyruvate to acetate and CO<sub>2</sub>. Anaerobically, glucose was fermented quantitatively to lactate, and pyruvate was dismutated to equimolar amounts of lactate, acetate, and CO<sub>2</sub>.

Studies of the mechanism of glucose metabolism in 1 strain (A5969) revealed a breakdown via the Embden-Myerhof pathway which involved a triphosphopyridine nucleotide (TPN) linked glyceraldehyde phosphate dehydrogenase. Lactic dehydrogenase, however, appeared to be diphosphopyridine nucleotide (DPN) linked.

Formation of AMC did not appear to occur via the " $\alpha$ -acetolactate" route common in most bacteria but rather by an "active aldehyde-acetaldehyde" condensation found in yeast.

In general, the fermentative PPLO closely resembled *Mycoplasma mycoides* and *Streptococcus faecalis* in the metabolism of glucose.

Because of the striking similarities between the fermentative organisms noted here, and the fact that PPLO in general may be closely related to L-forms of bacteria, it is suggested that this group of fermentative PPLO was derived from a common ancestral bacterium.

Microfilm \$2.50; Xerox \$5.00. 99 pages.

## BIOGRAPHY

"THE MOST ARROGANT MAN IN THE WORLD":  
THE LIFE AND WRITINGS OF HENRY HOME,  
LORD KAMES (1696-1782).

(L. C. Card No. Mic 60-4560)

Ian Simpson Ross, Ph.D.  
The University of Texas, 1960

Supervisor: Ernest Campbell Mossner

After Lord Kames's death, his family expected James Boswell to write his life. Boswell had interviewed Kames for this purpose and collected biographical material, but the project was another of those he abandoned. The task was then entrusted to Alexander Fraser Tytler (later Lord Woodhouselee), a former protégé of Kames, whose *Memoirs of the Life and Writings of the Honourable Henry Home* (2 vols.) appeared in 1807 and ran to a second edition (3 vols.) in 1814. Woodhouselee's book is dull and his treatment of sources unsatisfactory. No full-length biography of Kames has been attempted since Woodhouselee's and it is to supply this deficiency that the present dissertation was written.

Use has been made of Boswell's notes on Kames, now available in the *Private Papers of James Boswell from Malahide Castle* (18 vols., 1928-34). Further biographical information was yielded by Chapter I of Helen Whitcomb Randall's *The Critical Theory of Lord Kames* (1944); *New Letters of David Hume* (1954); and Ernest Campbell Mossner's *Life of David Hume* (1954). In addition, the writer had access to the Abercairny Collection containing the family papers of the Homes of Kames, which is now held in H. M. General Register House, Edinburgh. Letters by Kames in the British Museum and National Library of Scotland were also consulted.

The picture of Henry Home which emerges from a reassessment of the old evidence and a gathering of new material is a striking one. Bred a Jacobite and an Episcopalian,

he achieved eminence in a Whig-dominated society by dogged persistence in acquiring forensic skill. His merits were rewarded by appointment to the Court of Session and, in time, to the High Court of Justiciary, Scotland's supreme criminal tribunal. Home was no mere lawyer, however, but had a wide variety of interests, which included philosophical discussion, estate improvement, linguistic standards, political economy, the arts, natural science, and the settling of manufactures.

His ruling passion was a love of fame, but he accepted the possibility of reputation for others and delighted in acting as the patron of merit and beauty. Among those whom he counselled and assisted were David Hume, Adam Smith, James Boswell, and the poet William Hamilton of Bangour. Of the young ladies who were his "pupils," the best known was the vivacious Jane Maxwell, later Duchess of Gordon. Home sought, on occasion to exercise the authority as well as the solicitude of a father, to the exasperation of his protégés. Some such attitude lay behind David Hume's private comment on his former benefactor, that he was "the most arrogant man in the world." For all that, Home retained a circle of remarkable acquaintances to the end of his life. Benjamin Franklin was his guest and correspondent, as were Mrs. Elizabeth Montagu, the blue-stocking, and the philosopher Thomas Reid.

No life of a man is complete without some account of his ideas. In Home's case his thought is best represented by three of his works: *Essays on the Principles of Morality and Natural Religion* (1751); *Elements of Criticism* (3 vols., 1762); and *Sketches of the History of Man* (2 vols., 1774). These books are analyzed to show Home as an eclectic rather than original thinker, but one whose speculations concerning metaphysics, society, and, above all, literature have a significant place in the history of ideas. The conclusion drawn is that Henry Home, Lord Kames, is a man to be reckoned with in any responsible study of life and letters in eighteenth-century Britain.

Microfilm \$4.25; Xerox \$14.85. 329 pages.

## BIOLOGY - GENETICS

### CYTOGENETIC STUDIES OF ADVANCED GENERATIONS OF INTERSPECIFIC HYBRIDS BETWEEN *PHALARIS ARUNDINACEA* L. AND *PHALARIS TUBEROSA* VAR. *STENOPTERA* (HACK.) HITCH.

(L. C. Card No. Mic 60-5410)

David Carothers Allison, Ph.D.  
The Pennsylvania State University, 1960

Cytological studies of advanced generations of interspecific hybrids between *Phalaris arundinacea* and *P. tuberosa* were completed. The generations included in this study were the backcrosses 1 and 2,  $F_2$  progeny from the  $F_1$  hybrid, and  $F_2$  progeny from the doubled  $F_1$ . Chromosome counts were made on all generations and studies of meiosis were completed on the backcross 1 and 2 generations from prophase through pollen grain development.

Morphological comparisons and measurements of fertility were also completed on the backcross 1 and 2 generations.

The  $F_1$  hybrid was backcrossed to both *P. arundinacea* and *P. tuberosa* but only the cross to *P. tuberosa* met with success. *Phalaris arundinacea* did not provide results when used as a male parent. The backcross 1 plants were again backcrossed to *P. tuberosa*. The  $F_2$  progeny of the  $F_1$  hybrid were the result of open pollination in the field and the  $F_2$  of the doubled  $F_1$  were the result of open pollination in the greenhouse.

Cytological studies of the backcross 1 generation revealed the following  $2n$  chromosome numbers: 28, 29, 32, 33, 42, 43, and 55. Meiosis was irregular in all stages of development and multivalent configurations or multiple associations were the outstanding observation in prophase and prometaphase. Precocious movement of chromosomes was seen at both metaphase I and II, and laggards were observed at anaphase I and II. As many as 10 micronuclei were observed in some quartets at late telophase. Fertility was observed to have increased over  $F_1$  fertility. A wide range of phenotypic variation was also observed in the backcross 1 generation.

The backcross 2 plants that were analyzed had a euploid number of 35 chromosomes. Meiosis appeared to be increasing in stability over meiosis of the backcross 1 generation. Diakinesis was easier to analyze on the whole, and other meiotic stages appeared to show a better balance and more regularity. Fertility as measured by pollen stainability also was higher and the progeny had high phenotypic variability.

Chromosome counts of the  $F_2$  progeny of the doubled derivative were all about 56 chromosomes with one or two possibly having 55 chromosomes. These plants have never flowered for meiotic studies, although floral primordia were observed to form at the growing point. The eight plants which were studied have demonstrated extreme phenotypic uniformity.

A small sample of the  $F_2$  of the  $F_1$  hybrid has revealed the following  $2n$  chromosome numbers: 28, 29, 32, 44, and 46. These plants have not produced adequate inflorescences

for studies of meiosis. They have also shown extreme irregularity with reference to phenotypic expression.

In addition, sterility mechanisms and how they may be effecting this material, additional problems and ideas for the future development of other advanced generations, and the occurrence of supernumerary fragments in a plant of the backcross 1 progeny and possible derivations of these fragments were discussed.

Microfilm \$2.50; Xerox \$4.00. 73 pages.

### THE FEASIBILITY AND ADVISABILITY OF CHIRONOMID CONTROL WITH SPECIAL REFERENCE TO CHAUTAUQUA LAKE, N. Y.

(L. C. Card No. Mic 60-6505)

Ernest Clayton Bay, Ph.D.  
Cornell University, 1960

Observations, public opinion surveys, biological, ecological, and control studies were made on the chironomid and chaoborine fauna of Chautauqua Lake, N. Y., for four summers following the nuisance-ridden years of 1954 and 1955. These seasons, except for the latter part of 1959, were substantially cooler than those for 1954 and 1955. Following the month of July, 1956, larval populations of the species *Glyptotendipes lobiferus* (Say) and *Tendipes plumosus* (L.) declined substantially.

Variations in the rate and peak of emergence were recorded for *G. lobiferus* and *Tanytarsus* (*Endochironomus*) *subtendens* Townes. The latter species was found generally to increase in prevalence through the month of August and into September, while *G. lobiferus* was seldom numerous after the third week in July. One complete generation of *G. lobiferus* was reared over a span of two to four months; most individuals emerged within eight to ten weeks. Rearing of several other species was unsuccessful.

*Tendipes plumosus*, which is considered to be the most objectionable species nearest the lakeshore, emerges throughout the summer. However, its worst outbreaks occur in mid and late August, except for the lower lake which is similarly affected in late June and early July. Egg mass deposition by this species upon lighted objects is an unusual problem of considerable importance at Chautauqua Lake, while not reported in the literature pertaining to the nuisance of this midge at other lakes. This habit is described in detail.

A checklist of the Chironomidae and Chaoboridae for Chautauqua Lake is included, together with a detailed record of the three most prevalent species at each of four locations for each week of the summer of 1957. Minute *Tanytarsus* species, mostly *Tanytarsus* (T.) *confusus* (Mall.), together with several new species determined by Sublette, prevailed about the lake until mid-July and early August when *T. subtendens* replaced them at all locations



except Midway. Midway, because of its proximity to deep open water, attracts mostly females of *Chaoborus punctipennis* during this period, and occasionally heavy swarms of *T. plumosus*. The composition and intensity of midge swarms was found to vary regardless of weather.

Larvicidal screening showed granular formulations of two percent dieldrin, two percent aldrin, and ten percent lindane to be most promising at 0.05 to 0.1 pound per acre without endangering amphipods and miscellaneous invertebrate fauna. However, existing water pollution control laws prevented conclusive experiments with these materials.

No adulticide measures were found to give effective relief from intense midge flights, but portable thermal fog generators were useful against resting swarms of *Tendipes plumosus*. Powerful concentrations of artificial lighting at some commercial establishments seemed to afford protection to others.

Except for localized areas, public opinion did not seem to favor lakewide larviciding for 1959 or similar years, but would encourage it at other times. An up to date history of causes and control approaches for known aquatic midge problems is included for different parts of the world. In addition, detailed diagrams and descriptions for new rearing, emergence, and collecting devices which are of value in such studies are presented.

Microfilm \$2.55; Xerox \$8.80. 194 pages.

A CYTOLOGICAL AND GENETICAL STUDY  
OF THE CARNATION, *DIANTHUS*  
CARYOPHYLLUS, WITH SPECIAL REFERENCE  
TO THE PRODUCTION OF TRIPLOIDS.

(L. C. Card No. Mic 60-5218)

Howard Joseph Brooks, Ph.D.  
The University of Connecticut, 1960

A cytological study of the greenhouse carnation, *Dianthus caryophyllus*, showed that triploids are produced with difficulty from reciprocal diploid-tetraploid crosses and that the carnation tolerates a high degree of aneuploidy. Only 79 triploids were produced from 1130 reciprocal diploid-tetraploid crosses while 65 aneuploids were produced from the same crosses. In addition, 93 aneuploids were produced from crosses involving triploids.

Diploid X diploid crosses gave an average of 32.07 hybrids per cross, and tetraploid X tetraploid crosses resulted in an average of 4.23 hybrids per cross. From 648 diploid X tetraploid crosses, an average of 0.08 hybrids per cross was produced while an average of 0.49 hybrids per cross was produced from 482 tetraploid X diploid crosses.

The diploid X tetraploid crosses produced 7.1 percent triploids, 91.1 percent tetraploids and 1.8 percent aneuploids. The reciprocal tetraploid X diploid crosses produced 31.5 percent triploids, 41.6 tetraploids and 26.9 percent aneuploids. These aneuploids ranged in chromosome number from 42 to 49 around the triploid chromosome number of 45 and from 57 to 62 around the tetraploid chromosome number of 60. These aneuploids near the triploid and tetraploid chromosome numbers were not easily distinguished from the euploids.

Plants with an extreme condition of aneuploidy were recovered from 253 crosses involving triploids used as the seed parent. Progenies of triploid X diploid crosses showed a continuous range of chromosome numbers from 31 to 39 with a mode of 33. The vigor of these aneuploid plants decreased with an increase of the aneuploid condition and were easily distinguished from diploids which have a chromosome number of 30. The progenies of triploid X tetraploid crosses showed a continuous range of chromosome numbers from 50 to 58 with a mode of 54. These aneuploids were likewise distinguishable from euploids although the degree of abnormality and loss of plant vigor was less than the aneuploids near the diploid chromosome number.

A dominant gene (H) was isolated from the Chabaud strain of carnations which was found to influence flower doubleness in the greenhouse carnation. This gene shows complete dominance and produces a mean petal number of  $28.04 \pm 2.63$ . The D and E genes also influence flower doubleness in the carnation with these genes showing incomplete dominance. The E and the H genes are individually additive to the D gene in their effect on the number of flower petals, but epistasis exists between the E and the H genes.

The differences in mean flower petal number of clones selected from irradiated plants of the William Sim variety were found to be highly significant. These differences in mean petal number of the observed clones were associated with flower color; pink flowers had consistently more petals than white flowers.

The genetics of flower color in the carnation was studied from 90 diploid crosses and the findings confirm the published report that there are six major genes controlling flower color in the carnation.

Colchicine treatment of seeds was used to induce an autotetraploid condition in hybrid seedlings involving the Chabaud strain. While all other tetraploid carnation seedlings grew very slowly, these tetraploid Chabaud hybrids appeared to grow as well as diploids.

Microfilm \$2.50; Xerox \$5.20. 104 pages.

EFFECTS OF PARTIAL-BODY X-RADIATION  
ON LEARNING OF INBRED STRAINS OF MICE

(L. C. Card No. Mic 60-5882)

Ronald Leon Huff, Ph.D.  
Iowa State University of Science and Technology, 1960

Supervisor: John W. Gowen

Four-hundred r. whole-body X-radiation previously had been found by Huff (1958) to produce a decrement in maze acquisition of 2 inbred strains of mice (K and Z). The decrement was found to be strain-dependent. In order to study the nature of the effect, 397 inbred and hybrid mice were used. The purpose of the investigation was to find answers to the following questions: (1) is the decrement due to a primary or secondary effect on the brain; and (2) of what importance is the genotype of the animals regarding their response to the radiation?

Adult male mice from both strains (K and Z) were randomly assigned to 5 treatment combinations consisting of

control, whole-body, head third, mid third, and rear third. The second experiment contained the same treatment groups, and in addition, the head-mid, head-rear, and mid-rear groups were included. Another experiment involved whole-body X-irradiation of the male and female reciprocal hybrids. Control *K* and *Z* inbred mice were tested simultaneously for comparison with the control hybrids. The mice of all experiments were adapted in a straight water alley for 10 days, X-irradiated (400 r.), and given an inactive period (15 days in the first experiment, 22 days in the second, and 23 days in the third and fourth). Following the inactive period, each mouse was tested once daily in a modified T-water maze until he reached a criterion of 5 consecutive correct runs. The maze required learning by visual cue. Trials to criterion, number of errors, and time scores were recorded.

The results confirmed the previous conclusions that X-radiation caused a decrement in learning ability of mice. However, the strains showed differential responses to the treatment which indicated that the effect was strain-dependent. The irradiated *K*'s showed an increase in trial scores but the *Z*'s did not. Irradiation of any body third (head, mid and rear) or their combinations produced a trial decrement in maze performance of *K* mice. A reduction in motivation would explain the results. Females of both strains differed from their respective brothers in time per errors scores. The hybrid females differed from their brothers in both trials and time per error in such a way as to suggest a sex-linked type of inheritance. Irradiated hybrids showed an increase in number of errors per error trial. These results differed from results of other investigators, but the difference was apparently due to the influence of strain with regard to the response to X-radiation. Microfilm \$2.50; Xerox \$3.80. 69 pages.

#### VOLITIONAL ACTIVITY OF INBRED AND HYBRID MICE AS INFLUENCED BY X-RADIATION

(L. C. Card No. Mic 60-5883)

Sally Dachtler Huff, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: John W. Gowen

320 r whole-body X-radiation has previously been shown to cause a reduction in volitional activity in mice. The nature of this effect was examined, using a total of 506 inbred and hybrid mice, the object being to answer the following questions: (1) Is the response of the irradiated animal due to the involvement of a particular organ or group of organs, or is it a generalized reaction to quantity of body cells exposed? (2) Is the recovery exhibited by irradiated animals complete, or are there more permanent long-range effects of the treatment on activity? and (3) How are the different genetic backgrounds influencing the responses?

Adult male mice from two inbred strains (Ba and S) were classified according to levels of activity and given 320 r X-radiation to the following body sections: whole-body, head third, mid third, rear third, or none. Activity levels, measured by performances in activity wheels, were

recorded daily for 24 days after treatment. Mice receiving whole-body irradiation and control mice were retested between the ages of 8 and 12 months. Reciprocal hybrids also were tested after whole-body irradiation. Data include responses of only those animals that survived the entire test period.

Results confirmed the previous findings that whole-body irradiation causes an immediate reduction in activity, the magnitude and duration of which are dependent on genotype. Effects of partial-body irradiation are also strain-dependent and are not the same for all body thirds. Occurrence of the initial reduction appears to be tissue-specific, with damage to the intestinal epithelium or the hematopoietic system probably responsible at the dose used. The amount of tissue exposed is a primary factor in determining the duration of the initial reduction. A compensating action appears to be afforded by unexposed cells following radiation. Evidence for this action is provided by the response of whole-body-irradiated mice, which possess no unexposed cells, and by the failure to demonstrate the tissue-specific effect with partial-body irradiation in one strain.

The reduction in activity levels observed in 8- to 12-month-old Ba mice indicates that recovery to normal activity, shown within 3 weeks after the initial decline, does not preclude the existence of a more permanent radiation effect which may be associated with acceleration of the normal rate of physiological changes generally regarded as "aging."

Crosses between the S and Ba strains result in hybrids which are superior in normal activity level and in resistance to radiation to the more sensitive Ba parent, and are slightly superior to the less sensitive S parent, indicating a dominant and heterotic influence contributing to resistance.

The demonstration of a decrement in volitional activity caused by 320 r X-irradiation is significant because at this dose anatomical and physiological changes are difficult to detect directly, and there has often been the tendency to assume that 320 r has little or no effect. Physiological changes can be inferred from observation of a gross functional change, but the importance of the activity decrement *per se* in an irradiated population should also be considered.

Microfilm \$2.50; Xerox \$6.40. 134 pages.

#### METABOLISM OF MYO-INOSITOL AND INOSITOL HEXAPHOSPHATE

(L. C. Card No. Mic 60-6112)

Paul Porwen Hung, Ph.D.  
Purdue University, 1960

Major Professor: Bernard Axelrod

In spite of the biological importance of myo-inositol in animals, the metabolism of myo-inositol has not been fully established. A postulated catabolic metabolism of myo-inositol, in the rat as suggested by various workers, is as follows: Myo-inositol  $\rightarrow$  D-glucuronate  $\rightarrow$  L-gulonate  $\rightarrow$  L-xylulose + CO<sub>2</sub>. When myo-inositol-C<sup>14</sup> is used, soluble extracts of rat kidney produce radioactive CO<sub>2</sub>. However, indirect evidence previously obtained in this laboratory and



elsewhere suggests that the above scheme is not the only catabolic pathway of myo-inositol. An alternative pathway of myo-inositol metabolism in rat kidney is suggested for the following reason. Unlabeled D-glucuronate, when added in excess quantities to rat kidney homogenate which could convert myo-inositol- $C^{14}$  to  $C^{14}O_2$ , did not completely suppress the formation of  $C^{14}O_2$ . The particulate fraction from rat kidney cells has been reported to inhibit the formation of glucuronate from myo-inositol by the soluble extracts. It is yet to be established whether this inhibition is related to the alternative pathway.

Investigations were undertaken to clarify the nature of the inhibition exerted by mitochondria on glucuronate-forming system, also to detect, if possible, any intermediate products in the alternative pathway of myo-inositol metabolism.

That rat kidney mitochondria truly inhibited the formation of glucuronate from myo-inositol was based on the following observations: (a) Mitochondria decreased both the glucuronate formation and the oxygen consumption to the same extent. (b) Mitochondria did not utilize glucuronate.

In contrast to the native mitochondria, aged or heated mitochondria did not inhibit glucuronate formation. Nevertheless metabolic inhibitors which are known to affect oxidative phosphorylation, did not cause the mitochondria a loss in the inhibitory effect.

The inhibitory effect of the mitochondria was increased by prolonging the incubation period, by preincubating the mitochondria with myo-inositol, and by decreasing the concentration of myo-inositol.

Inositol monophosphate also inhibited the inositol oxidase activity, the inhibition decreased with increasing concentrations of inositol. Nevertheless, inositol monophosphate could not be detected in the incubated mixture of myo-inositol and mitochondria.

The inhibitory action of mitochondria on inositol oxidase was not caused by its effect on essential sulfhydryl groups or ferrous groups.

The observation by Agranoff that myo-inositol was incorporated into phospholipid by rat kidney preparations was substantiated. Moreover, using myo-inositol- $H^3$  as a tracer, it was possible to detect at least five radioactive compounds in the lipid fraction of the rat kidney preparations.

While phytate is widespread throughout the plant kingdom and is often regarded as a constituent unique to plants, it has been shown to occur in the nucleated erythrocytes of certain animals. Neither the function nor the metabolism of phytate is known. It is not yet clear whether the phytate is synthesized by the animal or whether it comes from the diet and simply accumulates in erythrocytes.

A small quantity of radioactivity appeared in the phytate of blood if day old chicks were injected with either inorganic  $P^{32}$  or myo-inositol- $H^3$ . Incubation of whole chicken blood with either inorganic  $P^{32}$  or myo-inositol- $H^3$  also resulted in the formation of radioactive phytate. Isolated chicken plasma as well as washed erythrocytes were capable of incorporating inorganic  $P^{32}$  into phytate. No intermediate compounds of phytate biosynthesis could be detected using chromatographic techniques.

Chicken blood cells were capable of absorbing both myo-inositol- $H^3$  and phytate aerobically, but failed to absorb

phytate in the anaerobic conditions. Rat blood cells failed to absorb phytate in contrast to a rapid absorption of myo-inositol- $H^3$ . Microfilm \$2.50; Xerox \$4.40. 83 pages.

# EFFECTS OF IN UTERO IRRADIATION UPON POSTNATAL DEVELOPMENT IN THE MOUSE

(L. C. Card No. Mic 60-4904)

Donald Joseph Nash, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: John W. Gowen

Three genetically differentiated inbred strains of mice and all their possible hybrids, including reciprocals, were used to investigate effects of *in utero* irradiation upon postnatal development of the progeny. Females were exposed to single, whole-body, 250 pkv X-ray doses on 6-1/2, 10-1/2, 14-1/2 or 17-1/2 days gestation as timed from the appearance of the vaginal plug following copulation. The study also included progeny that were irradiated on the day of parturition without any irradiation of the maternal organism. The X-ray doses employed were 0r, 20r, 80r, 160r and 320r. Progeny were examined at term for gross, external morphological abnormalities. Postnatal growth was followed from birth to 75 days, mice having been weighed at birth, 12, 26, 40, 60 and 75 days.

Morphological anomalies observable at birth were found only after irradiation at 10-1/2 days gestation with doses of 80r or more. Neonatal mortality was greatest following irradiation at 10-1/2 days. The  $LD_{50}$  at birth was found to be between 80r and 160r, with a dose of 320r causing all embryos to be stillborn.

A differential response both in the induction of malformations and in the incidence of neonatal deaths was observed between inbred and hybrid genotypes. A dose of 160r at 10-1/2 days caused 64 per cent abnormal and 100 per cent stillborn progeny among the inbreds compared to 29 per cent abnormal and 64 per cent stillborn among the hybrids.

Body weights were adjusted by making use of the pooled regression coefficient of body weight on litter size at birth over all treatments. The embryological age of 10-1/2 days was found to be most sensitive to growth retardation. The remaining stages in order of decreasing sensitivity were 14-1/2 days, 17-1/2 days, newborn and 6-1/2 days.

A dose of 80r at 10-1/2 days caused an 11 per cent decrease in birth weights. The maximum reduction was found after a dose of 320r at 10-1/2 days which caused a 56 per cent decrease in birth weights. Depression of birth weights was also seen after irradiation with 160r or 320r at 14-1/2 days. Embryos irradiated with 160r or 320r at 10-1/2 days or 320r at 14-1/2 days had no survivors or almost no survivors by a few days post-parturition.

The treatments producing significantly lower postnatal body weights were 80r at 10-1/2 days, 160r and 320r at 14-1/2 and 17-1/2 days and 160r and 320r to newborn progeny. The maximum effect was usually not reached until 40 days or more post-parturition, and there was little recovery by 75 days. The greatest effect at 75 days was

observed in those progeny that had received 320r as 17-1/2 day embryos. Body weight in these animals was 25 per cent lower than control weights.

Estimates of the components of variation were derived from an analysis of variance within each of the embryological ages. Genotypic differences in response became maximum 26 to 40 days after birth. Most of the differences are believed due to the early growth advantage of the hybrids over the inbreds, since by 75 days there were only small genotypic effects and only small differences between inbred and hybrid weights.

Differential responses of the genotypes to levels of irradiation reached a maximum of the total variation at 12 days when an average of almost 50 per cent was due to this effect. The effect has largely disappeared by 75 days. Genetically determined differences in response were thought to be expressed as the result of differences in developmental age of embryos at the time of irradiation and as the result of genetically determined differences in recovery from disturbed physiological activities.

Microfilm \$2.50; Xerox \$8.40. 185 pages.

SOME ASPECTS OF THE BIOLOGY  
OF THE EASTERN CHIPMUNK, *TAMIAS*  
*STRIATUS LYSERI* (RICHARDSON).

(L. C. Card No. Mic 60-6458)

Donald Russell Seidel, Ph.D.  
Cornell University, 1960

To attempt to ascertain some of the little known details of the biology of the chipmunk 252 animals were live trapped, marked by toe clipping, and observed continuously by means of recaptures from April 30, 1958 to April 30, 1960 in central New York. The sex ratio was 48% male and 52% female over the two year period.

Several burrows were excavated including one of the "extensive" type. The structure and contents are discussed and illustrated.

Chipmunks in this locality emerge from hibernation from mid-February to the end of March with males preceding the females. The majority of adults go underground in October but some of the young may be out until well into December. Torpidity was effected by exposure and starvation in July and August. A period of aestivation was not found to exist in the population studied.

Outside of the family unit there was little sociability and territorial behavior was of a limited and ill-defined variety. This species possesses a fall vocalization period during which they emit series of chirps, two or more per second, for periods of several minutes. One animal "singing" seems to elicit the same behavior in others. Only seven incidents of tree climbing were observed.

Adults rarely moved very far from their original territories but young animals dispersed varying distances from their birth site. Juveniles exhibited little homing ability but this was probably due to a stronger tendency to disperse. Adults homed for distances up to 1800 feet with no differences between sexes in this ability.

Estrus was observed from late March to early August, excluding May. Testes were descended in males at the spring emergence and appeared to begin regression into

the inguinal canals in May. Testes were not found to be actually in the coelom in any age group or in any season. Variation in size of the testes while in the inguinal canals was noted and reduction in size took place in late August and September. Chipmunks appear to be able to temporarily withdraw the testes from the scrotum at will.

The majority of litters were born in April and August and consisted of three to six (mean 4.25) young. Of 30 females, seven (23.3%) had two litters in one season. The eyes of the young opened between the 34th and the 40th day from birth and weaning took place between the 35th and 43rd day. The young made their first appearance above ground in June and late September or October when between 40 and 47 days of age. No chipmunks reached sexual maturity in the year of their birth, but most did so by the spring of the following year. The exceptions were several females of the summer litters. Lactation was observed in every month from April to September except July. Placental scars became fully absorbed during the ninth week after parturition.

Three species of mites, one louse, and five species of fleas were taken from chipmunks. Only 1.6% of 252 animals were parasitized by *Cuterebra* larvae and all infestations were in the inguinal region in late summer. In 27 specimens, five were infected with the trematode *Postharmostomum laruei* (caeca and colon), one contained the cestode *Hymenolepis diminuta* (small intestine), and 16 were infected with five species of nematodes of the genera *Syphacia*, *Trichuris*, and *Capillaria* (from the stomach to the colon).

Intermediate hosts of the trematode and cestode species are listed and correlated with the food habits of the chipmunk.

Very little predation was encountered. The gray squirrel was listed as a possible suspect. Few road kills were observed. Only 9.8% of 51 individuals were known to have lived to the age of three years and 14% of 149 animals were known to survive to the age of two years. These ages are minimal and some could possibly have been older in both groups.

Microfilm \$2.50; Xerox \$7.20. 153 pages.

A MUTABLE LUTEUS LOCUS IN MAIZE

(L. C. Card No. Mic 60-5891)

James Douglas Smith, Ph.D.  
Iowa State University of Science and Technology, 1960

Supervisor: Peter A. Peterson

A study was made of an unstable chlorophyll-deficient characteristic that was found among the progeny of maize seeds irradiated at the Bikini tests. The general behavior of the mutable luteus ( $l^m$ ) locus is described, and an hypothesis is presented to explain the mechanism underlying its instability.

The seedling phenotype associated with the mutable luteus complex is characterized by a pale yellow background containing numerous dark green stripes. This phenotype is quite variable in expression, being subject to modification with respect to background color and to



mutational pattern. Phenotypic expression is also influenced by temperature, the frequency of sectors being increased by higher temperatures within the temperature range tested.

Since the expression of the luteus phenotype was always accompanied by mutability, it was concluded that the instability at this locus is autonomous in nature, i.e., no external controlling element is required to induce mutational events.

The site of mutable luteus activity has been localized as being approximately one crossover unit removed from the su<sub>1</sub> locus in the short arm of chromosome 4. The linear gene order is presumed to be centromere l<sup>m</sup>su<sub>1</sub>gl<sub>4</sub>.

The element controlling the activity at the mutable luteus locus is transposable, and the appearance of other variegated phenotypes within certain mutable luteus populations would seem to indicate that this element may be capable of inducing instability at other loci. Indirect evidence also suggests the possibility that, under some conditions, this controlling factor may cause chromosomal breakage events to occur at its point of association.

The hypothesis is proposed that an autonomous controlling element, designated Inhibitor-mutator (Im), suppresses the normal action of the gene L when these factors are juxtapositional. If Im is transposed to a different site or is lost, normal gene function is restored to L. This hypothesis follows McClintock's mutable gene scheme in that it is assumed that no structural alteration of the normal genic element occurs.

Microfilm \$2.50; Xerox \$3.80. 68 pages.

#### GENETIC VARIANCES IN AN OPEN-POLLINATED VARIETY OF CORN ESTIMATED FROM FULL-SIB AND HALF-SIB PROGENIES

(L. C. Card No. Mic 60-4910)

John Caswell Williams, Jr., Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: Lowell H. Penny

In the study of the inheritance of quantitative characters in corn a considerable number of estimates of some of the relevant genetic parameters have been obtained experimentally. Because various models, assumptions, and populations were used to obtain the estimates, critical comparisons of the various approaches have not been feasible, and moreover, the estimates are not yet adequate for acceptable generalization in choosing breeding systems to be followed.

To get comparisons for some of the estimates an ex-

periment utilizing a single open-pollinated variety of corn was designed to estimate genetic variances from relationships such as full-sibs, half-sibs, uncle-nephews, first cousins, double first cousins, and so forth. In the present and initial study estimates were obtained from full-sibs and half-sibs only.

Phenotypic variance, covariance of full-sibs, and covariance of half-sibs were estimated from two samples of 192 progenies derived from crosses within a strain of the Reid Yellow Dent open-pollinated variety without inbreeding. The additive genetic variance,  $\sigma_A^2$ , and the dominance variance,  $\sigma_D^2$ , for yield of shelled grain, ear length, ear diameter, number of kernel rows, and weight per 100 kernels were estimated under the assumptions of no linkage and no epistasis. The additive genetic variance for one of the samples of progenies was considerably larger than the dominance variance for all five characters. In the other sample the dominance variance was larger for yield, ear length, and weight per 100 kernels. The contrasting results and the high standard errors of the estimates indicated the problem of obtaining adequate and reliable estimates of the genetic variances.

An empirical interpretation of the ratio  $\sigma_D^2/\sigma_A^2$  indicated that there was only partial dominance or a combination of partial dominance and overdominance in one sample of progenies. Overdominance was indicated for yield and ear length in the other sample. However, it was pointed out that linkage or epistasis would lead to estimates in the overdominance range when actually there was no overdominance. A brief discussion of the biases due to linkage and epistasis was given.

The genotype x year interactions were statistically significant for yield, ear length, ear diameter, and number of kernel rows in one of the samples of progenies grown for two years. The estimates of heritability for yield obtained from both the components of variance procedure and the parent offspring regression procedure were low, but ranged from 25 to 50 percent for the other characters. The genetic and phenotypic correlations between pairs of characters were computed. For some of the characters the two correlations were somewhat divergent. Genetic correlations between yield and the other four characters ranged from .32 to .65.

Using the estimates of the heritabilities and genetic correlations, the expected changes in yield due to selection and intercrossing of the superior 5 percent of the progenies were computed. In terms of mean yield, the expected change in yield due to selection was estimated to range from 8.6 percent when the selection criterion was yield itself to .4 percent when the selection criterion was weight per 100 kernels. However, selection for ear diameter would produce an expected change in yield 72 percent as effective as selection for yield itself, and it was suggested that in early stages of selection in this population, selection for ear diameter might be quite efficient.

Microfilm \$2.50; Xerox \$4.40. 84 pages.

## BOTANY

### INVESTIGATIONS OF THE BASIS OF SELECTIVE ACTION OF DALAPON

(L. C. Card No. Mic 60-5589)

Robert Neils Andersen, Ph.D.  
University of Minnesota, 1960

Studies were conducted in an attempt to find an explanation for the selective herbicidal action of 2,2,-dichloropropionic acid(dalapon). Sugar beets (*Beta vulgaris* L.), a species tolerant of dalapon, and yellow foxtail (*Setaria lutescens* (Weigel) Hubb.), a species susceptible to dalapon, were the test species.

Dalapon was absorbed and translocated in both species when the herbicide was applied either to the leaves by droplet or to the roots by addition to nutrient solution. Dalapon accumulated in the younger (more metabolically active) tissues of both species.

Post-emergence application of dalapon caused protein degradation in the shoots of both species. Proteins were broken down to amino acids. Further breakdown of the free amino acids with the liberation of ammonia was indicated in both species. The amides (primarily glutamine in sugar beets and asparagine in yellow foxtail) appeared to act in detoxification by serving as storage sites for the released ammonia in both species.

The free pantothenic acid level in the shoots of sugar beets was decreased one day after treatment with dalapon. Only a slight suggestion of a decrease in free pantothenic acid was apparent in the shoots of yellow foxtail one day after treatment with dalapon. The free pantothenic acid level in the shoots of both species rose after one day following treatment with dalapon.

In sugar beets, visually observed recovery of the dalapon-treated plants was accompanied by a general return of the levels of the various chemical constituents studied to levels nearer those found in untreated plants.

The basis of dalapon's selectivity between the two species appears to lie in the ability of the sugar beets to recover from the initial herbicidal injury. It is suggested that this ability to recover is due to metabolic inactivation of dalapon by the sugar beet plant. A possible metabolic derivative of dalapon was found in the aqueous extract of sugar beets which had received a post-emergence application of a field rate (4 lbs. per acre) of commercial dalapon in addition to a tracer amount of radioactive dalapon. No evidence of such a derivative was found when only a tracer amount of radioactive dalapon was applied to sugar beets, and no evidence of such a derivative was found in yellow foxtail even when the tracer amount of radioactive dalapon was supplemented by a field rate of commercial dalapon.

Microfilm \$2.50; Xerox \$4.00. 73 pages.

### INVESTIGATIONS INTO THE FOLIAR ANATOMY AND ONTOGENY OF CERTAIN SPECIES OF THE GENUS *ILEX* L.

(L. C. Card No. Mic 60-4823)

Ralph Page Ashworth, Ph.D.  
The University of North Carolina, 1960

Supervisor: Joseph Edison Adams

An investigation into the midvein anatomy and ontogeny of foliage of the several southeastern species of *Ilex* was carried on. Sections were made through leaves of various stages of growth of these several species at the following levels: pulvinus; 1/2 petiole; petiole-blade junction; 1/4 blade; 1/2 blade; 3/4 blade; and a locus near the leaf tip.

It was found that the vascular tissue in midribs of such foliage basically forms an ectophloic siphonostele of which there are adaptive modifications in the different species. The terms "open" and "closed" siphonosteles were used for these modifications. Closed siphonosteles were considered to represent a less derived condition than open ones.

Extra-stelar fibers were found to develop around the stele from cortical tissue. These typically mature after the stele is fully differentiated.

From among the several species of *Ilex* studied various stages of midvein ontogeny of six species were described. It was found that protoxylem initiation does not occur in young midveins of these species in the same manner that has been described in certain other angiosperms. In *Ilex* midveins protoxylem is initiated and differentiates acropetally from the base of the provascular strand. Furthermore, there are impetuses for vascular differentiation which result in the following: (a). centrifugal differentiation of xylem from pith to phloem within a vascular bundle; (b). abaxial-to-lateral-to-adaxial differentiation of xylem through the vascular bundles which comprise the stele; (c). basipetal and acropetal differentiation of the metaxylem from the region of maximal vascularity within the stele. This region of maximal vascularity was found to be between the junction of petiole-blade and the first quarter of the blade.

Pressures were found to exist in the maturing stele which cause the protoxylem elements to be crushed so that protoxylar lacunae are formed. Such pressures often continue to the extent that the lacunae are obliterated.

Three leaf traces were found to extend from the siphonostele of the stem into the petioles of *I. opaca* Ait. foliage. Only one trace was found to enter petioles of other species studied. However, in *I. cassine* L. small masses of cells were found in the nodal areas and proximal portions of petioles which were suspected to be reduced lateral traces. On the basis of this it was felt that in *Ilex* the leaves with three vascular traces exhibit a less derived condition than those with a single trace.

Microfilm \$2.50; Xerox \$8.80. 191 pages.



THE INFLUENCE OF VARIOUS  
FACTORS ON THE RATE OF  
TRANSLOCATION OF FLUORESCEN  
IN GOSSYPIUM HIRSUTUM L.

(L. C. Card No. Mic 60-4829)

Richard Glenn Bowmer, Ph.D.  
The University of North Carolina, 1960

Supervisor: V. A. Greulach

The rate of translocation of di-sodium fluorescein through the phloem of cotton plants (Gossypium hirsutum L.) is approximately 75 times faster than its rate of diffusion through agar at the same temperature, the translocation rate in cotton plants being about 5.6 cm/hr at 25°C.

A brief anatomical study of the cotton petiole and stem was made. Sieve tube elements in internodes of various lengths were measured, and it was found that in plants with short internodes the sieve tube elements were shorter than in plants with longer internodes. Tall plants with long internodes had a higher rate of fluorescein translocation than did short plants with shorter internodes, probably because there were fewer sieve plates/cm to be transversed.

Temperature experiments indicated an optimum temperature for translocation of 25-30°C. The curve obtained is similar to that for other metabolic processes and indicates metabolic processes are involved in translocation.

Respiratory inhibitors which block various steps in the Krebs's cycle were applied to cotton plants, and after an 18 hour interval their effect on oxygen absorption was determined. Inhibitors used were: difluoroacetic acid, iodoacetic acid, sodium pyrophosphate, maleic acid, sodium sulfate, and sodium arsenite. All the inhibitors generally reduced both oxygen absorption and translocation rate significantly, statistical analysis indicating positive correlations of varying degree in most experiments.

1000 ppm maleic hydrazide reduced both the rate of translocation and oxygen absorption, while 1000 ppm Amo 1618 had no effect on either process. 100 ppm gibberellic acid and indoleacetic acid, and 100 and 1000 ppm 2,4-D did not affect oxygen absorption but significantly increased translocation. One and 10 ppm gibberellic acid and indoleacetic acid had no effect on translocation, while 10 ppm and 2000 ppm 2,4-D reduced the rate.

Calcium nitrate significantly decreased the rate of translocation of fluorescein, while sodium nitrate increased the rate, and a mixture of the two had no significant effect.

It is concluded that metabolic processes in the phloem have a definite influence on the rate of translocation, that sieve tube element length increases with internode length, that the rate of translocation increases with internode length because of the fewer sieve plates traversed per unit length, and that increased membrane permeability may result in increased rates of translocation. The fact that growth-promoting substances increased the rate of translocation without increasing oxygen consumption indicates that metabolic processes other than respiration may be involved. Both the data on membrane permeability and on sieve tube element length indicate that at least some rate limiting factors are localized in the sieve plate region. The data secured in this study do not provide conclusive evidence for or against any of the theories of phloem translocation, but seem to fit electrokinetic or cytoplasmic streaming theories better than the mass flow theory.

Microfilm \$2.50; Xerox \$4.80. 94 pages.

SOIL AS A FACTOR INFLUENCING  
DISTRIBUTION OF VEGETATION  
IN THE SANDHILLS OF NEBRASKA

(L. C. Card No. Mic 60-4580)

Donald F. Burzlaff, Ph.D.  
Utah State University, 1960

Major Professor: Dr. L. A. Stoddart

The sandhills of Nebraska consist of 12 million acres of continuous grassland. Although they occur within a climate that is generally devoted to a more intensive type of agriculture, these grasslands remain untilled because of a single environmental influence--the soil.

This study was initiated to determine the extent of influence of certain edaphic characteristics on the flora of the upland sandhill ranges.

The vegetation of the upland sandhill ranges was divided into three range sites. Study areas were set up at 24 different locations within each of these three sites. Edaphic and vegetation characteristics were studied at the 72 study areas during the years 1957 and 1958.

Soil samples were taken from each study area at the four predetermined depths of 0-6, 6-12, 12-24, and 24-48 inches during the fall of 1957. These samples were subjected to laboratory analysis for determination of physical and chemical properties.

The physical analyses included determination for bulk density, particle density, particle-size analysis, moisture retention at specified tensions, and organic matter content.

Chemical analyses were made to determine soil reaction, available phosphorus, cation-exchange capacity, and exchangeable potassium, calcium, magnesium, and sodium.

Significant differences were established between sites for all edaphic characteristics measured. This would support delineation of range sites on the basis of soils alone. Mean values were listed for the physical and chemical properties of the soils of each site.

Correlations of the percent of particles in the silt-clay fraction and the organic matter content of the soil with the moisture retention ability and with the cation-exchange capacity indicated these characteristics to be highly interdependent variables.

The vegetation phase included an inventory and analysis of the flora by range site. The inventory was made during the summer of 1958 by a method that involved the point-frame quadrat and line transect.

The flora of each range site was divided into four structural units called unions. This stratification was based on an understanding of the ecologic amplitude, phenology, and life-form. Calamovilfa longifolia was found to be a dominant species on all range sites.

Andropogon hallii, Andropogon scoparius, Bouteloua hirsuta, Calamovilfa longifolia, Sporobolus cryptandrus, and Stipa comata were subjected to intensive study because they showed high constancy on all range sites and yet exhibited significant differences in composition percentages between sites.

Correlations of the composition percentages of these six species with certain edaphic characteristics showed that Andropogon hallii, Bouteloua hirsuta, and Stipa comata were significantly correlated with cation-exchange capacity, percent organic matter, and the percent of moisture retained between 1/10 and 15 atmospheres of tension by the surface six inches of soil. These three soil

characteristics, together with soil texture, were considered to be the soil factors most influential in controlling the distribution of vegetation in the sandhills of Nebraska.

It was theorized that those species exhibiting a narrow range of tolerance to minor changes in the soil factor were of more value as indicators of a specific soil condition than those species with a broad tolerance range for changes in the same factor.

Microfilm \$2.50; Xerox \$7.60. 163 pages.

#### THE PSAMMOPHYTES OF THE CAROLINA FALL-LINE SANDHILLS

(L. C. Card No. Mic 60-4835)

James Alan Duke, Ph.D.

The University of North Carolina, 1960

Supervisor: Dr. A. E. Radford

Quadrats and mass collections are reported for the xeric sands of the fall-line sandhills from the Briar Creek in Georgia to the Neuse River in North Carolina. The fall-line sandhills, available in part to plants since, and probably during the Cretaceous, constitute the oldest habitat for psammophytes on the Atlantic coastal plain. Younger sand ridges toward the coast support a similar flora with perhaps a higher incidence of slightly more mesophytic species. The flora is characterized by a high percentage of perennial, xeromorphic and fall-flowering species. Paleontological evidence suggests that the flora has been derived from a subtropical xerophytic portion of the southeastern Mesozoic flora (with some influx of western species during Pliocene), which in later periods has repeatedly converged on the deep South, later to reradiate and occupy its present range. The species show a strongly equilateral divergence to the northeast and west from Florida. Of those few psammophytes that have advanced markedly up the Mississippi Valley, many occur in the fixed dunes around the Great Lakes and in the pine barrens of New Jersey. In the course of this investigation three thousand specimens of some five hundred psammophytic species were collected in ruderal and undisturbed xeric areas.

Microfilm \$2.50; Xerox \$4.40. 84 pages.

#### THE EFFECT OF GIBBERELIC ACID ON CELL DIVISION AND CELL ELONGATION IN STEMS OF LYCOPERSICUM ESCULENTUM

(L. C. Card No. Mic 60-4840)

John Gamage Haesloop, Ph.D.

The University of North Carolina, 1960

Supervisor: Victor A. Greulach

Experiments were carried out to determine the effects of gibberellic acid (GA) on cell elongation and cell division in stems of the garden tomato, Lycopersicum esculentum. Anatomical studies were made of the pith of the first

internode of tomato stems at time intervals of two days to four weeks after treatment with GA so that the effects of GA on cell size and number could be followed during the development of this tissue to maturity. The pith of GA-treated plants had a smaller final diameter than that of untreated plants, but the final lengths of the first internodes of treated plants were, as usual, much greater than those of the controls. Gibberellic acid increased the length of pith cells, but restricted the radial and tangential enlargement of these cells. Gibberellic acid had no effect on cell number across the pith but greatly increased the final number of cells in the longitudinal axis of the pith, although an increase in cell number could not be detected until beyond four days after treatment.

From cell measurements made at short time intervals after treatment and from experiments which showed that GA treatment increases the rate of geotropic curvature of tomato stems, it was concluded that GA increases the rate of cell elongation in tomato stems. If acceleration of the rate of cell elongation is a typical GA effect in plants, then the conclusion that GA-induced growth is primarily a consequence of increase in cell length and that GA has no effect on increase in cell number is not valid if such a conclusion is based on cell measurements made a short time after treatment.

Indications of an antagonistic interaction between maleic hydrazide (MH) and GA were found from anatomical studies of the first internodes of plants treated simultaneously with both compounds.

Observations on the over-all growth of GA treated and control plants showed that GA increased stem height, caused slight chlorosis of the leaves, caused the formation of entire-margined leaflets, and increased the rate of formation of visible leaves. The time of appearance, number, and size of flower buds was not affected by GA treatment. Although the total dry weight of the shoots of tomato plants was not affected by GA treatment, the dry weight of the stems increased at the expense of leaf dry weight.

Microfilm \$2.50; Xerox \$5.60. 114 pages.

#### SOME FACTORS AFFECTING GROWTH AND PRODUCTION OF MOTILE CELLS IN FIVE CHLOROCOCCACEAN ALGAE

(L. C. Card No. Mic 60-4702)

Kenneth Farrell Hancock, Ph.D.

University of Alabama, 1960

Growth and motile cell production were studied in Chlorococcum echinozygotum, C. hypnosporum, Bracteococcus minor, Neochloris terrestris, and N. gelatinosa under controlled conditions of temperature and illumination. When examined on the first day after transfer, all species were observed to produce zoospores freely in distilled water except N. gelatinosa, which did so infrequently. Zoospores were not produced by N. terrestris and B. minor above osmotic concentration 0.040 M, by C. hypnosporum above 0.0565 M, by N. gelatinosa above 0.1065 M, and C. echinozygotum above 0.1735 M. When examined on the first day after transfer to media of varied pH, none of the organisms studied was observed to produce zoospores in media below pH 3.4 nor above pH 9.4. Near maximum



percentages were produced by all species between pH 5.0 and 7.4. Cultures of each species which had been grown in media containing 2.9412 millimoles of  $\text{NaNO}_3$ ,  $\text{NaNO}_2$ , or urea as the N source produced high percentages of motile cells upon inoculation into basal medium or distilled water; whereas in media containing similar concentrations of  $\text{NH}_4\text{NO}_3$  or  $\text{NH}_4\text{Cl}$ , the number of zoospores produced was reduced. When cells of each organism which had been cultured in media deficient in various macro-minerals were inoculated into basal medium, relatively high percentages of zoospores were produced in each case. When cells of each organism which had been cultured in medium containing equimolar amounts of Sr as a Ca replacement were inoculated into fresh basal medium, high percentages of zoospores were produced. With cells which had been grown in basal medium or in medium containing Sr as a Ca replacement, the effects on zoosporogenesis varied with the concentration of Sr present. The reduction in number of zoospores produced on successive days in individual cultures, the fact that zoospores are formed freely under a wide variety of conditions, plus a proportional reduction in percentages of zoospores produced when cells are transferred to solutions containing distilled water and graduated amounts of cell-free supernatant from old cultures, indicate that a substance inhibitory to zoosporogenesis is produced by growing cells and accumulates in the culture medium.

Equimolar concentrations of  $\text{NaNO}_3$ ,  $\text{NH}_4\text{NO}_3$ ,  $\text{NH}_4\text{Cl}$ , and  $\text{NaNO}_2$  were found to be almost equally effective as a source of N for growth; marked increased growth over these occurred in media containing urea. The optimum concentration of the former three N-sources was found to be between 0.5882 and 1.4706 millimoles. Growth measured turbidimetrically in media deficient in various macro-minerals was much less than in control cultures. A growth requirement for Ca was demonstrated for *N. gelatinosa* and *C. echinozygotum* but not for the others. The optimum  $\text{CaCl}_2$  concentration for growth was found to be about 5 to 10 mg. per liter. Sr was apparently utilized for growth by each species when Ca was omitted from the medium, but optimum concentrations of Sr for growth appeared to be much less than for Ca.

Cells of *N. terrestris*, *C. hypnosporum*, and *C. echinozygotum* adhered in clumps when grown in media containing equimolar amounts of Sr as a Ca replacement. The extent and consistency of the gelatinous sheath about cells of *N. gelatinosa* were directly related to the Ca concentration of the medium. The extent of this sheath varied with the concentration of Sr when used as a replacement of Ca, but the texture remained watery in all concentrations. There was an increase in maximum cell diameter and in intensity of pigmentation of the chloroplast, and there appeared stigma-like bodies in many cells above average in size in media containing high concentrations of Sr as a Ca replacement.

Microfilm \$2.50; Xerox \$6.00. 124 pages.

## THE INFLUENCE OF AGE ON THE CATION EXCHANGE CAPACITY OF PLANT ROOTS

(L. C. Card No. Mic 60-4582)

Einard Stephen Haniuk, Ph.D.  
Utah State University, 1960

Major Professor: Dr. R. L. Smith

The effect of plant age on the cation exchange capacity (CEC) of excised plant roots was studied. Root segments were electrodyalized and then placed in a KCl solution which was subsequently titrated. The me. of KOH used to titrate the root-KCl solution for a 5-minute interval was considered to be equivalent to the CEC of the particular root sections, expressed as me./100 g. of dried root material.

CEC of excised corn, barley and bean root sections 5 cm. long changed with plant age. Corn and barley root CEC started off low, rose to a peak at an age of 10 to 14 days, after which it dropped off and remained lower than the peak. Bean root CEC on the other hand started off lower than that of corn and barley, but slowly rose until at 3 weeks it surpassed that of corn and barley roots. In all cases the 1 to 6 cm. sections of roots had the highest CEC.

Using 1 cm. root sections of beans, corn, PI and Hawk-eye soybeans, it was found that the 1 to 2 cm. sections had the highest CEC. Average CEC values for corn and bean roots had the same change with age as did the larger sections of roots.

A study of adsorption and absorption of iron by excised corn root sections was performed with the aid of the radioisotope  $\text{Fe}^{59}$ . It was found that the iron adsorbed and absorbed was generally highest on the sections with the highest CEC. Less iron was absorbed and adsorbed by the corn roots at the 4 week than at the 10 to 12 day age.

Excised bean root sections with the highest CEC adsorbed the highest amount of iron. The increase in CEC of bean roots with age was paralleled by an increase in the amount of iron adsorbed. Less iron was absorbed by the bean roots at the 5 week than at the 12 to 14 day age.

Microfilm \$2.50; Xerox \$3.80. 66 pages.

## MONOGRAPHIC STUDIES IN CASSIA (LEGUMINOSAE-CAESALPINIOIDEAE). I. SECTION XEROCALYX.

(L. C. Card No. Mic 60-4548)

Howard Samuel Irwin, Jr., Ph.D.  
The University of Texas, 1960

Supervisor: B. L. Turner

A portion of the genus *Cassia* was studied with the intent of determining its relationship to the rest of the genus. This portion, designated by Bentham the subsection Xerocalyx of section Chamaecrista, is elevated to sectional rank on the weight of the following evidence: consistent occurrence of three principal petiolar trace bundles enclosed by a ring or arc of collenchyma, and two strongly developed, abaxially oriented ridge bundles; parallel or divergent major venation of leaflets; striately multinerved

sepals; unequal length of calyx components; finely pitted seeds 1.5 or more times longer than wide; chromosome number of  $n = 7$ ; relative pattern homogeneity of chromatographed floral pigments. Study of comparable characters in representatives of other sections of *Cassia* revealed much variation and in some instances, especially in the sections *Chamaecrista* and *Absus*, patterns similar to those exhibited in *Xerocalyx*. However, section *Xerocalyx* is quite distinct from all other infrageneric taxa in *Cassia* in chromosome number and major leaf venation, and very nearly so in sepal venation and seed form.

The taxonomic history of the genus is discussed as is the relationship of the section *Xerocalyx* to other sections. An artificial key to the 16 species and 15 varieties is followed by description and discussion of each taxon. Twelve new taxa and 4 new combinations are proposed. *Cassia calycioides*, placed by Benthham in his subsection *Xerocalyx*, and the very similar *C. aristellata* are, on the basis of total characters, transferred to the section *Chamaecrista*. Microfilm \$3.95; Xerox \$13.95. 308 pages.

#### THE PLANT ECOLOGY OF THE FRANKLIN BLUFFS AREA, ALASKA.

(L. C. Card No. Mic 60-4672)

John James Koranda, Ph.D.  
The University of Tennessee, 1960

Major Professor: Royal E. Shanks

This study was carried out in the White Hills Section of the Arctic Coastal Plain, the northernmost land surface of arctic Alaska. The Franklin Bluffs area, site of the present study, is one of the units of the Sagavanirktok formation (Tertiary) which locally overlies the Cretaceous in this portion of the coastal plain.

The purpose of this study is descriptive, - to describe and document the plant ecology of the Franklin Bluffs area which is unique for geological and topographic reasons but which includes the range of major vegetation types and patterns characteristic of the Arctic Coastal Plain. The Franklin Bluffs area is divided into study sections and the vegetation patterns of each are described in detail. The basis of the divisions is usually the presence of a distinguishing topographic feature, in addition to the usual range of surface conditions. The following divisions of the Franklin Bluffs area are considered:

1. Lower Franklin Bluffs Section.
2. Outlier Section.
3. Terrace Section.
4. Pink Bluffs Section.
5. Patterned Ground Section.
6. Bruce Bluffs Section.
7. Upland Section.
8. Interfluvial Section.

The topographic units are the basic descriptive units in this ecological study and are of three primary types: the river valley, the bluffs, and the upland tundra. These topographic units are essentially the specific plant and animal habitats of the area, and are representative of the Arctic Coastal Plain. Within each section of the study

area, several examples of the three primary topographic units are described.

The methods used in this study are basically reconnaissance, collection, vegetation mapping, and the measurement of certain physical features of an area such as degree of slope and aspect. Species lists and habitat ranges are given for many of the sections or portions of sections. Quantitative sampling was used in the vegetation types such as the upland tundra that cover large units of the topography. The line plot list sample 50 feet long on which 150 readings were made was found to give an adequate representation of a vegetation type for descriptive and comparative purposes. Aerial photographs were used in the field studies and mapping done directly on overlays made on enlarged aerial photographs. A series of aerial photographs with transparent overlays and interpretation of the vegetation types are included for five of the study sections.

The descriptions of the three primary topographic units in the Franklin Bluffs area include, within the river valley, gravel bars and terraces; on the bluffs, alluvial fans, ravines, and talus slopes; and the rolling upland surface. In the description of the upland vegetation of the Franklin Bluffs area, a general discussion of the extent, variation, and composition of the upland vegetation on the Arctic Coastal Plain is included.

The discussion of the plant ecology of this arctic area emphasizes the close relationship between topography, vegetation types, and certain ecological factors such as exposure, snow cover, and substratum conditions.

Microfilm \$3.40; Xerox \$11.95. 261 pages.

#### EFFECTS OF LIGHT INTENSITY AND QUALITY ON PLANT MATURITY

(L. C. Card No. Mic 60-4450)

Beyoung Hwa Kwack, Ph.D.  
University of New Hampshire, 1960

Experiments with a dwarf pea, *Pisum sativum* L. cultivar "Little Marvel," were conducted to study effects of various light intensities and qualities on the production of dry weight of pods and number of seeds per plant, under light-laboratory conditions.

Some preliminary experiments showed that under equal intensities of seven different light qualities, the greatest yields were obtained with red, lesser yields with blue, incandescent, pink, warm white, yellow, in that order, and the least with green light.

The yields per plant increased with the intensity of the various light qualities, with no saturation for any light intensity achieved, while the yields per lumen decreased as the intensity increased beyond certain levels.

Among 18 different light qualities tested in combination or alone, warm white plus incandescent or warm white light alone resulted in the greatest yields, while green gave least yields, when the number of lamps, their distance from the plants, and other environmental conditions were equal. The efficiency of the lights in their influence on the yields per lumen was found to be greatest with red plus blue and least with green light.

Among single light qualities tested the greatest yields



per lumen were obtained with red, and lesser yields with blue, incandescent, pink, warm white, yellow, in that order, and the least with green light. These results are concordant with those in preliminary experiments with equal light intensities.

The addition of incandescent to fluorescent light usually resulted in greater yield than with either of these lights used alone. The reason for this effect is not known.

Microfilm \$2.50; Xerox \$7.00. 146 pages.

#### THE GENUS *SAXIFRAGA* L. IN THE SOUTHERN APPALACHIANS

(L. C. Card No. Mic 60-4675)

Lois Pearl Lord, Ph.D.

The University of Tennessee, 1960

Major Professor: A. J. Sharp

The Southern Appalachian species of the genus, *Saxifraga*, were studied using morphological, ecological, and geographical data. It was found that the genus is represented in the area by five species: *Saxifraga virginensis*, *Saxifraga careyana*, *Saxifraga caroliniana*, *Saxifraga michauxii*, and *Saxifraga micranthidifolia*.

*Saxifraga tennesseensis* was found to be only a local variant of *Saxifraga careyana*.

The morphological characteristics that are of significance in distinguishing these species are: pubescence-type, sepal-position, corolla-shape, shape and length of stamen-filaments, and the nature of the hypanthium.

Present data indicate that *Saxifraga micranthidifolia* and *Saxifraga michauxii* are limited to the Blue Ridge Province. *Saxifraga careyana* is found on the Cumberland Plateau, in the Ridge and Valley Province and in the mountains of east Tennessee, of western North Carolina, and southwestern Virginia. *Saxifraga caroliniana* is found only in five counties of western North Carolina and southwestern Virginia in the Blue Ridge Province. *Saxifraga virginensis* extends from eastern Canada to northeastern United States and southward to Alabama and Georgia.

It is suggested that *Saxifraga stellaris* was the ancestral stock which gave rise to *Saxifraga michauxii* and that *Saxifraga nivalis* was the ancestral stock from which *Saxifraga virginensis* was derived. It is suggested that *Saxifraga careyana* possibly arose as a hybrid between *Saxifraga michauxii* and *Saxifraga virginensis* or from their ancestral stocks and that subsequent hybridizations resulted in this rather variable species. *Saxifraga caroliniana* possibly arose as a mutant from *Saxifraga careyana*.

Microfilm \$2.50; Xerox \$5.60. 112 pages.

#### A STUDY OF THE MUMMY DISEASE OF THE CULTIVATED MUSHROOM, *AGARICUS CAMPESTRIS* L. EX FRIES.

(L. C. Card No. Mic 60-5448)

Edward L. Merek, Ph.D.

The Pennsylvania State University, 1960

The causal agent of the mummy disease of the cultivated mushroom, *Agaricus campestris* L. ex Fries, has not been determined. In previous studies of this disease no organisms could be identified as pathogens by Koch's Postulates, and since, in all cases, the mushroom mycelium itself was present in the inoculum in all successful transmissions of the disease, it was postulated that a virus may be the causal agent. However, no successful transmissions were made when spores or mycelium from diseased sporophores were used as inoculum.

This study attempted to correlate the appearance of the disease with some cultural procedures and to identify the nature and habitat of the causal agent.

From observations at fourteen different infestations no specific commercial growing practices could be associated with the incidence of the disease. Apparently composting materials, pasteurization procedure, origin of the spawn, soil treatment, and crop management did not have any outstanding significance.

Five fungi, a yellow *Trichoderma viride*, a *Fusarium* sp., a *Dictyostelium* sp., an *Acremonium* sp., and an unidentified phycomycete were isolated from samples of soil, compost, or rhizomorphs of diseased sporophores but not from comparable materials from unaffected areas. None of these organisms induced the production of diseased sporophores when introduced experimentally into cased mushroom trays. Neither protozoa nor nematodes were found in affected areas that were not found in unaffected areas.

Initial experiments indicated that water infusions from soil or compost from affected areas could induce the production of "open-veiled" mushrooms. This phenomenon could not be substantiated in later experiments. Treatment of soil or compost from an affected area with propylene oxide rendered the materials noninfectious. The disease could not be transmitted from the white strain of the cultivated mushroom to the golden-white or cream strains, but could be transmitted to other white strains.

The limited transmissibility between genetically distinct cultures of the cultivated mushroom indicates that it is important in future studies to use the same strain in experimental infestations. Varietal response may also be used to determine if infectivity is dependent upon the ability of one variety or strain to anastomose with the hyphae of another variety or strain.

The mycelium of *Agaricus campestris* was never isolated from compost capable of transmitting the disease. It would appear that further investigations on this disease should concentrate on the isolation and testing of *Agaricus campestris* mycelium from materials proven infective.

Microfilm \$2.50; Xerox \$3.60. 64 pages.

STUDIES ON THE LIFE HISTORY  
AND DEVELOPMENT OF  
*PRINGSHEIMIELLA DIOICA* COUCH

(L. C. Card No. Mic 60-4850)

John Thomas Mullins, Ph.D.  
The University of North Carolina, 1960

Supervisor: John N. Couch

The rediscovery of the chytrid *Pringsheimiella dioica* Couch is reported. Four isolates of the fungus have been collected from Highlands, North Carolina, and kept in culture during the past year.

*Pringsheimiella dioica* is an endobiotic, holocarpic chytrid and occurs as an obligate parasite on members of the Saprolegniaceae. The asexual or zoosporangial portion of the life cycle is initiated by posteriorly unflagellate zoospores which leave a cyst on the host wall. The endobiotic thallus resulting from such an infection then produces a parasite zoosporangium. The parasite zoosporangia occur as sori and the sori assume the size and shape of the host zoosporangia. Each parasite zoosporangium has a discharge papilla.

*Pringsheimiella dioica* is heterothallic and the sexual portion of the life cycle is initiated by the fusion of compatible isoplanogametes. Fusion occurs only between the spores derived from two separate plants. The biflagellate zygote then infects the host and gives rise to a thick walled resting spore which is contained in a sporangium.

Microfilm \$2.50; Xerox \$4.80. 94 pages.

EXPERIMENTAL INVESTIGATIONS  
OF THE RELATIONSHIPS OF  
CERTAIN SOIL ALGAE WITH THEIR  
ASSOCIATED MICROORGANISMS

(L. C. Card No. Mic 60-4556)

Bruce Covell Parker, Ph.D.  
The University of Texas, 1960

Supervisors: Harold C. Bold and Jackson W. Foster

An *in vitro* ecological study of algae and other microorganisms isolated from a sample of Texas soil was conducted. Special attention was devoted to studies of biotic relationships between algae and other organisms in two-membered cultures containing the original soil as the nutrient medium. Of 143 different two-membered combinations examined, more than 50 per cent involved algal stimulation, while less than 15 per cent involved algal inhibition. The data indicated that, in most cases, heterotrophic microorganisms stimulated growth of algae.

A simple mathematical expression called the "Interaction Value" was introduced to express the degree of biotic affinity between two different organisms.

Fifteen of the initial 143 two-membered combinations were studied under three different sets of climatic factors in the laboratory. The three most interesting and stable associations were chosen for more detailed investigations of the causal mechanisms. These associations were:

(1) a species of *Bracteacoccus* which was stimulated in

growth by a heterotrophic bacterium; (2) a species of *Chlamydomonas* which was enhanced in growth, motility, and akinetogenesis by an actinomycete, the latter being enhanced in growth and conidia production by the alga; and (3) a species of *Phormidium* which was inhibited by a fungus.

A series of experiments led to the disclosure of the mechanism of stimulation of *Bracteacoccus* by the bacterium. It was shown that growth of the alga in the soil was limited by a deficiency of available nitrogen, and that the bacterium was capable of decomposing complex nitrogenous substrates in the soil, releasing a part of the nitrogen as ammonia which was readily assimilated by the alga. The results supported the view that the biotic relationship was of ecological significance, occurring naturally.

Mutual stimulation of growth of *Chlamydomonas* sp. and the actinomycete was shown to be caused, in part, by oxygen-carbon dioxide relationships. Motility of the alga was influenced by reduction of available nitrogen in the medium, increase of carbon dioxide, and enzymatic decomposition and assimilation of the extracellular polysaccharide of the alga by the actinomycete. The depletion of nitrogen and presence of certain sugars from the polysaccharide of the alga enhanced production of conidia by the actinomycete. Both depletion of nitrogen and an unidentified factor stimulated akinetogenesis by *Chlamydomonas*. Some evidence indicated that the unidentified factor might be streptomycin or a related antibiotic substance.

The mechanism underlying the fungal inhibition of *Phormidium* sp. remains unresolved. Some evidence suggested that acidic, fungal-dissimilation products arising from the decomposition of extracellular substances of *Phormidium* might be inhibitory to the latter.

The effects of *Bracteacoccus* sp. and of the heterotrophic bacterium on sterile tomato seedlings growing in tubes of Texas soil were investigated. Both microorganisms separately promoted growth of the seedlings in the artificial rhizosphere. However, when both were associated, no stimulation of the tomato seedlings occurred. Measurements of length, fresh-weight, dry weight, and total nitrogen supported these conclusions.

A brief survey of the heterotrophic capabilities of the algal isolates revealed that eight of the twelve algae tested were capable of growth in glucose-salts medium in complete darkness. *Bracteacoccus* sp., a facultative heterotroph, failed to increase in Texas soil during more than a year in darkness when in pure culture, although most cells remained alive, but when combined with the heterotrophic bacterium in darkness, it increased fifteen-fold. Experiments with pure cultures of the alga in ashed and unashed Texas soil extract in both bright and dim light confirmed the ability of *Bracteacoccus* to utilize for growth a portion of the natural, organic substrates in the soil extract at sub-optimal light intensities. The literature relevant to these investigations and certain general concepts have been summarized.

Microfilm \$2.95; Xerox \$10.35. 227 pages.



# RESPIRATION, GROWTH AND DEVELOPMENT IN THE MAIZE ROOT APEX.

(L. C. Card No. Mic 60-4559)

Aaron Rosenfield, Ph.D.  
The University of Texas, 1960

Supervisor: W. Gordon Whaley

Cell number and desoxyribonucleic acid content per cell were determined over successive segments of primary root tips of maize. It was found that a desoxyribonucleic acid content of  $52.80 \times 10^{-12}$  grams per cell was relatively constant in this material. This indicated that the degree of polyploidy in this material was quite low or non-existent. Furthermore, desoxyribonucleic acid values and cell number values were in good agreement in each of the segments measured. Thus, desoxyribonucleic acid can serve as an index of cell number in the material examined. Reasons are given for desoxyribonucleic acid superiority over other factors as a base line for calculations.

Oxygen uptake, as a measure of gross metabolic activity, fresh weight, dry weight, volume, and total soluble and protein nitrogen also were determined in the successive segments of the root. These results were correlated with results of cell growth and growth of the root.

It was found that the changes in respiratory activity, on a per unit desoxyribonucleic acid basis, paralleled the changes that occur for total nitrogen, protein nitrogen, and dry weight. Fresh weight and volume changes were parallel to the changes in oxygen uptake and nitrogen values over the first few millimeters. Beyond the first three millimeters, respiratory activity and nitrogen values decreased, whereas fresh weight and volume continued to increase. This is taken to indicate that the initial stages of growth involve the synthesis of protoplasm and an increase in water content.

The later stages of growth and elongation are primarily due to water uptake in the cells that are increasing in size, for there is a decrease in nitrogenous constituents and dry weight in the same cells where volume and fresh weight are increasing.

Microfilm \$2.50; Xerox \$4.20. 76 pages.

# STUDIES ON THE ICELANDIC *ELYMUS*

(L. C. Card No. Mic 60-6493)

Björn Sigurbjörnsson, Ph.D.  
Cornell University, 1960

Preparatory studies for breeding the Icelandic *Elymus* were carried out. Two species of *Elymus*, *E. arenarius* and *E. mollis*, had been reported to grow on the island and an attempt was made to determine the extent to which each species was represented. For this purpose morphological studies were carried out on specimens from 74 localities throughout the country and chromosome numbers were determined for specimens from 54 of the localities. All specimens studied were found to belong to the octoploid ( $2n=56$ ) *E. arenarius*. One specimen was found to have the aneuploid number  $2n=55$ . Plants of *E. mollis* ( $2n=28$ ) were not found.

Study was also made of traits reported to be helpful in differentiating between the two species. As compared to *E. mollis* plants introduced from Alaska most of these traits in the Icelandic *E. arenarius* were found to overlap, although two traits, pubescence of culm tops and pubescence of rachis, were found to be fairly reliable.

Several specimens of the reportedly awnless *E. arenarius* were observed to have distinctly awned lemmas.

Attempts at hybridizing *E. arenarius* and *E. mollis* failed.

It was concluded that until *E. mollis* is rediscovered in Iceland *E. arenarius* should be considered to be the only member of this genus in the country.

The question whether *Elymus arenarius* represents a native or introduced species in Iceland was considered. The possibility that the formerly reported *E. mollis* may have represented fairly recent introductions which now appear extinct was discussed.

A survey of variability in *E. arenarius* was carried out. For this purpose five areas were selected for study and within each area forty plants were selected at random. Measurements were made on these plants *in situ* and root cuttings of the plants were grown in replicated trials at Gunnarsholt, Iceland where measurements were made on the same characters for two years. Seeds of the selected plants were space-planted in a replicated nursery at Gunnarsholt and the progeny studied for emergence, survival rate, and some seedling characters. A considerable range in variability was observed. Differences between the five areas and within each area revealed that some of this variability is heritable and could serve as a basis for breeding superior varieties. The variability could be differentiated into patterns depending on locality. It was concluded that the populations at the five areas studied represented fairly distinct ecotypes and within each population there existed a number of biotypes. One of the ecotypes was found to be superior agronomically to the other four with reference to most of the characters studied.

Some evidence for the fact that evolution of agronomically superior traits seemed to have occurred under the more favorable environmental conditions, and conversely, that the least development of these traits appeared under the less favorable conditions was presented.

Germination, emergence, and flowering were found to be very slow and erratic. A method of hastening germination by rupturing the pericarp was described.

Studies on meiosis revealed a high degree of regularity in division; 28 bivalent configurations being most commonly observed.

Studies were also made on ability to set seed under bags. A relatively high degree of self-fertility was observed. Performance of seedlings of the  $S_1$  generation as compared to an open-pollinated control was equal.

On the basis of self-fertility and general habit of growth of native plants it was suggested that in typical *Elymus* communities in Iceland fertilization by self-pollination is likely more prevalent than by open-pollination.

Microfilm \$2.50; Xerox \$7.80. 169 pages.

# ECOLOGICAL ADAPTATIONS OF ANNUAL PLANTS IN SOUTHERN WISCONSIN

(L. C. Card No. Mic 60-6529)

Gwendolyn Jessica Struik, Ph.D.  
The University of Wisconsin, 1960

Supervisor: Professor John T. Curtis

Selected annual and perennial plants, occurring naturally in southern Wisconsin, were studied for growth-pattern differences. Thirty-seven herbaceous species were divided into the following four categories and compared: ten forest annuals and biennials, eleven forest perennials, ten open-habitat annuals and biennials, and six open-habitat perennials. The forest species were sampled in one or more of three native forest stands. The open-habitat plants were obtained from a sand-barrens site.

Each week fresh and dry weight measurements were made of the below-ground portions of the plants, the above-ground portions and the floral parts. During the flowering-time each plant was weighed to find the amount of water lost before the plant wilted.

It was found that the annuals have a higher above-ground importance (above-ground weight/entire-plant weight) than do the perennials. Further, the above-ground part of the annual plants has a higher water content than that of the perennials of the same habitat and of the same above-ground importance. Annuals lose a lower percentage of their water content before wilting than do the perennials with which they are associated and forest plants lose a lower percentage of their water content before wilting than do open-habitat plants.

The adaptive significance of this evidence appears to lie in the fact that the major weight of annual plants is concentrated in the photosynthetic and reproductive aerial organs and not in below-ground structures. The high succulence and ready wilting of annual aerial parts suggest turgor pressure as a means of stem and leaf support, while perennial stems are supported more by cell wall development.

The sexual reproductive energy (floral-organ weight/above-ground weight) of the annuals was found to average more than twice the amount in the perennials. When the vegetative reproductive energy of the perennials was calculated (increase in root weight during one growing season/above-ground weight) and added to the sexual reproductive energy, this total was found to be eight times the total (sexual) reproductive energy of the annuals. This difference in reproductive energies between annuals and perennials is thought to be related to overwintering of the perennial organs during winter conditions when annuals are usually in the less vulnerable seed form. In addition, the root provides reserves from which the perennial stems of heavier dry weight are formed.

In all the contrasting characters by which open-habitat annuals differed from open-habitat perennials, the forest annuals were found to differ from the forest perennials in the same direction, but not always by the same magnitude. Some of these characteristics are possibly critical factors in enabling annuals to survive the shade and competition of a forest environment.

Each of the eight forest annuals is discussed in terms of its particular adaptations to a forest environment. The annuals are Amphicarpa bracteata, Chaerophyllum

procumbens, Ellisia nyctelea, Floerkea proserpinacoides, Galium aparine, Impatiens pallida, Parietaria pensylvanica and Pilea pumila.

Microfilm \$2.70; Xerox \$9.45. 208 pages.

# CHROMOSOME NUMBER AND INHERITANCE IN DENDROBIUM SPECIES AND HYBRIDS

(L. C. Card No. Mic 60-6495)

Thavorn Vajrabhaya, Ph.D.  
Cornell University, 1960

Chromosome numbers of 18 species and 29 commercial hybrids of Dendrobium were determined; chromosome inheritance was studied in five diploid crosses, five diploid-triploid crosses and in one cross of a near-pentaploid and a diploid; and cytological observations on microsporogenesis and pollen formation were correlated with breeding behavior. Fifteen of the 18 species counted were diploids with a gametic number of 19 and one species had somatic number of 40; one triploid and one tetraploid with the multiple chromosome number of 19 were identified. Among commercial hybrids, there were eight triploids, two tetraploids, and one near-pentaploid; the remainder were diploids.

Microsporogenesis and microgametogenesis of various diploids, triploids, a tetraploid and a near-pentaploid were studied. Among the diploid species, intrasectional and intersectional hybrids, irregularities in meiosis were rarely observed, but there was pollen abortion in the intersectional hybrids. Irregularities in meiosis of triploids, a tetraploid and a near-pentaploid were studied. Spores with unreduced chromosome number were frequently found in both diploids and triploids. The prevalence of unreduced chromosome numbers in spores indicates that polyploids might be produced from the crosses involving these plants, if the unreduced gametes are functional.

Chromosome inheritance in diploids and heteroploids was investigated in order to determine the extent to which aberrant types of gametes were functional. One triploid was found among 38 seedlings obtained from 5 diploid crosses. In the progenies of  $3n \times 2n$  crosses, 37 of 121 seedlings had chromosome numbers higher than those of the triploid parents; the remainder had chromosome numbers ranging from 38 to 57. In a near-pentaploid  $\times$  diploid cross, all of the seedlings had chromosome numbers ranging from the triploid to near-tetraploid numbers.

Aneuploid Dendrobium seedlings grew normally without showing any weakness due to the unbalance of chromosome number, but their frequency of occurrence was less than expected. This might have been due to the non-functioning of aneuploid gametes or the inviability of the embryos.

Microfilm \$2.50; Xerox \$4.80. 93 pages.



THE MEASUREMENT OF CARBON  
FIXATION IN CLEAR LAKE, IOWA,  
USING CARBON-14.

(L. C. Card No. Mic 60-4908)

Cornelius Irenius Weber, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: John D. Dodd

Measurements of primary productivity were made, using light and dark bottle methods, during the periods June 23-November 26, 1958, and April 18-August 12, 1959. Only small differences in productivity were observed at three widely separated points in the lake. Daily variations in productivity at one station were not greater than 2 fold, and were highly correlated ( $r = 0.81$ ) with total incident light energy. The productivity of the lake during the summers of 1958 and 1959 differed only slightly. The mean net primary productivity during the period May 2-October 18 (1958 or 1959) was 1.40 gm. carbon/m<sup>2</sup>/day, and gross productivity was estimated as 1.95 gm. carbon/m<sup>2</sup>/day. The mean net gain in organic matter at the plant level for the period May 2-October 18, 1958, was 0.85 gm. carbon/m<sup>2</sup>/24 hours. The efficiency of utilization of incident light energy for the period June 23-July 23, 1958, was 0.72 per cent.

Photosynthesis in sample bottles held at, or near, the water surface was measurably inhibited by high light intensities. Net photosynthesis in such samples exposed for 3 two-hour periods (using fresh plankton samples for each period) was 20 to 40 per cent greater than in samples exposed continuously for the same six-hour period.

The oxygen method of measuring primary productivity was used concurrently with the carbon-14 method on many occasions. A photosynthetic quotient of 1.00 was used to interpret the oxygen data, and productivity measurements with the two methods were in close agreement.

Phytoplankton samples, taken from the lake at 4-hour intervals and illuminated at 1100 f.c. in a constant temperature bath, showed a diurnal variation in capacity to carry on photosynthesis, with maximum rates of net photosynthesis in early morning. Net photosynthetic rates of successive samples declined steadily during the day reaching a minimum at night. The diurnal changes in photosynthetic rates did not parallel changes in the chlorophyll *a* content of the phytoplankton. Minimum respiration rates occurred in samples showing minimum capacity for photosynthesis.

Total chlorophyll content of the phytoplankton (1959) ranged from 51.2 to 161.8 mg./m<sup>2</sup>. At the depth of maximum photosynthesis a net average of 4.9 mg. of carbon was fixed per hour per unit of chlorophyll *a*.

The maximum ash-free weight of seston was 17.7 mg./liter in 1958 and 29.3 mg./liter in 1959. Large seasonal variations were observed. The coefficient of correlation between the ash-free weight of seston and optical density of the lake water was 0.93. Seasonal variations in the concentration of dissolved organic carbon were small, averaging 22.6 mg./liter in 1958 and 28.3 mg./liter in 1959.

Rates of photosynthesis per plankton unit, of unialgal cultures of 5 species of Clear Lake algae (*Pediastrum boryanum*, *Staurastrum gracile*, *Anabaena spiroides*, *Nitzschia palea*, and *Nitzschia communis*), varied as much as 30 fold. The variation in rates of photosynthesis per unit volume of algae was considerably less (8 fold).

Microfilm \$2.50; Xerox \$3.80. 69 pages.

## CHEMISTRY

### CHEMISTRY, GENERAL

#### THERMAL DECOMPOSITION OF SOME MEDIUM SIZED 1-METHYLCYCLOALKYL ACETATES

(L. C. Card No. Mic 60-6504)

George Smith Denning, Jr., Ph.D.  
Cornell University, 1960

The 1-methylcycloalkyl acetates of the eight, nine and ten membered carbocycles have been prepared and pyrolyzed at 500°. After titration of the liberated acetic acid, each of the pyrolysates was distilled by gas chromatography using silicone oil and silver nitrate-tetraethylene glycol columns. Data are recorded below.

#### Pyrolysis of Medium Sized 1-Methylcycloalkyl Acetates

Ring Size	Temp. °C	Yield of Olefins, %	Exo- cyclic, %	cis, %	Endo- cyclic trans, %	Dienes, %	Un- known, %
8	505	91	14.0	73.4	0	11.4	1.2
9	500	87	20.8	42.8	0	34.2	2.2
10	460	93	18.0	41.9	33.6	4.0	2.5
10	505	83	14.5	33.0	14.5	31.6	6.4

A low boiling fraction, consisting of the 2-methyl and 3-methyl- $\alpha,\omega$ -dienes, was obtained from the pyrolysis of each acetate. Structure proof for these was based on the physical constants, quantitative hydrogenation, infrared and NMR spectra. The dienes were probably formed by ring opening of the initially formed cyclic monoolefins. An intermediate boiling fraction was not characterized but the following structural types were suggested by the available data: isomerized dienes, isomerized cyclic monoolefins and bicyclic components. The highest boiling fraction consisted of cyclic monoolefins which were identified by infrared, physical constants and retention times on gas chromatography columns compared with those of authentic olefin samples. No acetate was recovered after the pyrolyses.

To learn more about the behavior of the cyclic monoolefins on pyrolysis, samples of olefin mixtures from the eight, nine and ten membered rings were pyrolyzed and the products analyzed by gas chromatography. The following information was obtained. (1) Between 5 and 10% of the olefins were degraded into lower molecular weight fragments. (2) An intermediate boiling mixture of unidentified products was present in each of the olefin pyrolysates. These mixtures were similar to those obtained earlier from the corresponding acetates. (3) The product distribution was roughly the same from the pyrolysis of the cyclic olefins as from the corresponding acetate.

Microfilm \$2.50; Xerox \$6.40. 132 pages.

#### THE REACTION OF DECABORANE WITH AROMATIC AMINES

(L. C. Card No. Mic 60-5355)

Bruce Franklin Dietrich, Ph.D.  
University of Delaware, 1960

Supervisor: Harold C. Beachell

An investigation was made of the reaction of decaborane with aromatic amines. Stoichiometric studies and elemental analyses indicated that the products of the reaction were hydrogen gas and a solid composed of two molecules of amine and one molecule of decaborane. A structure was proposed for the diaminedecaborane based on considerations of the nature of the reaction, electronic distribution in the reactants and correlations with known reactions and products.

Kinetic studies based on the rate of gas evolution were made on a series of decaborane-amine reactions. Rate constants were determined for several reaction temperatures and the activation energies were calculated. Mechanistic postulations were made. These were supported by the kinetic data, elemental analyses, spectral data, and information on the nature of the decaborane molecule given in the literature.

Microfilm \$2.50; Xerox \$3.60. 64 pages.

### CHEMISTRY, ANALYTICAL

#### THERMOMETRIC TITRATIONS AND THE THERMODYNAMICS OF REDOX REACTIONS

(L. C. Card No. Mic 60-5431)

Gordon J. Ewing, Ph.D.  
The Pennsylvania State University, 1960

Thermometric titrations have been applied to the systematic investigation of important inorganic oxidation-reduction reactions in aqueous sulfuric acid media. Cerium(IV), dichromate and permanganate were selected as oxidants, and ferrocyanide, ferrous sulfate and titanous sulfate as electron donors. The analytical applicability of thermometric titrations to redox analysis was investigated. Heats of reaction were determined and reaction entropies were evaluated.

Plots of temperature versus volume of added titrant were automatically recorded yielding well defined curves for concentrations between 0.0005 and 0.01 M. Titrametric end points and heats of reaction were determined graphically by linear extrapolation procedures. The temperature change was monitored by a thermistor bridge coupled with a recording potentiometer. A constant-flow buret was used



to deliver the titrant. Ordinate projections of titration curves were calibrated calorimetrically with the aid of an electric heater.

Because of the interdependence between proton transfer and electron transfer equilibria, the protonation thermodynamics of ferrocyanide and ferricyanide were investigated by potentiometric titration with a strong acid. All three ionization constants of  $\text{H}_3\text{Fe}(\text{CN})_6$  were found to be greater than 0.1. At 25° C the ionization constants of  $\text{H}_4\text{Fe}(\text{CN})_6$  were determined as:  $K_1 > K_2 > 0.1$ ;  $K_3 = (6 \pm 2) \times 10^{-3}$ ;  $K_4 = (6.7 \pm 0.3) \times 10^{-5}$ . The heats of protonation corresponding to  $K_3$  and  $K_4$  were 0.0 Kcal/mole. Protonation entropies were calculated and interpreted in terms of water "frozen" in the vicinity of the various hydrated ions. Utilizing protonation data obtained in this study, the formal potential of the ferrocyanide-ferricyanide couple in sulfuric acid media was calculated on a rigorous theoretical basis yielding potentials which were in excellent agreement with experimentally determined values reported in the literature.

The following thermodynamic parameters were determined for the oxidation of ferrous sulfate and of ferrocyanide by ceric sulfate:

REDOX THERMODYNAMICS AT 25° C  
IN 0.5 M SULFURIC ACID

Reaction	Formal Parameters		
	$\Delta H_o'$ Kcal/m	$\Delta F_o'$ Kcal/m	$\Delta S_o'$ eu
Ce(IV) - Fe(II)	-24.2 ± 0.6	-17.5	-23 ± 2
Ce(IV) - $\text{Fe}(\text{CN})_6^{-4}$	-9.9 ± 0.3	-17.3	+25 ± 1

The application of volumetric end point determinative procedures to thermometric titration curves proved to be an excellent quantitative method of analysis. The precision and accuracy was 1% and 2% for concentrations of  $10^{-3}$  M and  $10^{-4}$  M respectively. Divalent iron and trivalent titanium in a binary mixture were determined with standard ceric sulfate with separate end points being apparent by changes in the slope of the titration curve. Titrations of this type are possible whenever the successive free energies and heats of reaction differ by 3-5 Kcal/equivalent.

The heat evolved during a titration can be made use of as a method of direct enthalpimetric quantitative analysis with nonstandardized titrants. Heats of reaction were reproducible to within 2% for concentrations as low as  $5 \times 10^{-4}$  M. The method is ideally suited for micro-samples because the measured temperature change depends solely on concentration.

A combined end point determinative and enthalpimetric procedure has been devised for the analysis of binary mixtures which do not yield discrete potentiometric or thermometric end points. If the relevant heats of reaction differ by at least 10 Kcal/mole, both unknowns can be determined by solving a simultaneous set of mass and heat balance equations.

Microfilm \$2.50; Xerox \$5.80. 119 pages.

PART A: STUDIES OF ORGANIC SOLVENT  
ENHANCEMENTS IN FLAME PHOTOMETRY.  
PART B: STUDIES OF THE EXTRACTION  
AND FLAME EMISSION OF MAGNESIUM.

(L. C. Card No. Mic 60-4671)

Jack Hudgens Knox, Jr., Ph.D.  
The University of Tennessee, 1960

Major Professor: John A. Dean

PART A: STUDIES OF ORGANIC SOLVENT  
ENHANCEMENTS IN FLAME PHOTOMETRY

The present investigation has been concerned with the study of several parameters which influence the flame photometric emission of elements in an effort to elucidate the nature of the intensifications observed with organic solvents. Parameters such as flame temperature, OH band intensity, ionization, sample flow rate, and the emission intensities of different elements in different solvents have been studied.

Temperature calculations have shown that the temperature of an organic-fed flame is slightly higher than that of a water-fed flame but that the temperature difference is not large enough to give the intensifications found. Neither could the OH band intensity measurements be related to the intensifications. Comparison of OH intensities among the different solvents showed large variations with changes in the acetylene-oxygen ratio.

The effect of a large quantity of electrons upon the emission intensity of lithium was studied with respect to flame conditions. However, an optimal hydrogen-oxygen ratio was found to be optimum both in the presence of and the absence of the element furnishing the large quantity of electrons.

The emission intensity of lithium was studied as a function of sample flow rate in water and in ethanol. The effect of the combustion of the ethanol upon the emission intensity is shown quite clearly. The temperature contribution of the burning ethanol shifted the optimum sample flow rate to a greater value.

Studies of the emission intensities of several elements in different solvents have shown that the emission intensity of each element depended more upon the solvent than upon the excitation energy of the transition. The intensifications are postulated as arising from chemiluminescence in the reaction zones of the burning solvent droplets. Rather than being confined to a narrow region of inter-conal gases, the reaction zone is enlarged and extended into the flame mantle when an organic solvent is employed.

PART B: STUDIES OF THE EXTRACTION  
AND FLAME EMISSION OF MAGNESIUM

The emission intensity of the 285.2-mu magnesium line has been measured as a function of the acetylene flow rate under a variety of conditions. A higher acetylene flow rate was required to give the maximum emission intensity as higher portions of the flame were observed. As a result of solvent combustion, magnesium solutions in 4-methyl-2-pentanone required less acetylene to give maximum emission intensity than did aqueous solutions of magnesium.

A study of the calibration curve of magnesium showed self absorption to be severe in the different regions of the

flame. A plot of the logarithm of the emission intensity versus the logarithm of the concentration was linear down to at least 25 ug. per ml.

An extraction procedure for magnesium showed that some of the interferences which hinder flame-photometric methods could be eliminated or minimized.

Microfilm \$2.50; Xerox \$5.20. 101 pages.

#### ACID-BASE EQUILIBRIA IN ANHYDROUS FORMIC ACID

(L. C. Card No. Mic 60-5680)

John Clifford Marshall, Ph.D.  
State University of Iowa, 1960

Chairman: Professor Alexander I. Popov

The use of anhydrous formic acid as a strongly acidic non-aqueous solvent has many advantages. Formic acid is much more strongly acidic than glacial acetic acid and its dielectric constant is about 60 at room temperature. The disadvantages of this solvent are that it is unstable, has an extremely high ion product, and is very difficult to obtain anhydrous.

A closed system vacuum distillation apparatus was designed from which anhydrous formic acid of consistent high quality could be prepared in a routine manner. The physical constants of the acid prepared would seem to indicate that it is as good as any reported in the literature.

A special apparatus for the performance of acid-base titrations in formic acid, under an inert atmosphere, has also been designed. Using this system, sodium formate, caffeine, urea, sodium sulfate, theobromine, strychnine, and several substituted metrazoles and tetrazoles were titrated. The titrations were carried out potentiometrically using quinhydrone on platinum for the indicator electrode and p-toluenesulfonic acid for the titrant acid.

Titration curves obtained were in all cases well defined.

The standard sodium formate-quinhydrone reference electrode was found to be a reliable and stable reference system in formic acid solutions. This reference electrode was found to be quick to equilibrate and reproducible to  $\pm 0.1$  mv.

A method has been developed for the direct potentiometric measurement of base strengths in anhydrous formic acid. This method makes use of a concentration cell in hydrogen ion in formic acid solutions. The variation of the e.m.f. of the concentration cell established was found to agree very closely with values predicted by theory. The pKb values were measured for several weak bases in this solvent with an apparent uncertainty of  $\pm 0.05$  pKb units.

Formic acid was found, in general, to act as a leveling solvent for weak bases. The instability of this solvent, particularly in acid solutions, does make its routine use as a non-aqueous solvent seem quite unlikely.

Microfilm \$2.50; Xerox \$5.80. 118 pages.

#### PART I: ROTATORY DISPERSION STUDIES OF SOME SUBSTITUTED

$\alpha$ -PHENYLETHYL AMINES.

#### PART II: LITHIUM ALUMINUM HYDRIDE-ALUMINUM CHLORIDE REDUCTIONS.

(L. C. Card No. Mic 60-6123)

Stanley Franklin Osman, Ph.D.  
Purdue University, 1960

Major Professor: James H. Brewster

Part I. A series of optically pure p-substituted  $\alpha$ -phenylethyl phthalimides were prepared. The method of preparation involved converting optically pure 1- $\alpha$ -phenylethyl amine to the corresponding phthalimide. This was nitrated and reduced to the amine. The amine was converted by diazotization to the p-chloro, p-bromo, p-iodo and p-methoxy derivatives. The rotatory dispersion for these compounds were measured and from these data values for the constants of a two term Drude expression of the form:

$$[M] = -\frac{A}{\lambda^2-x} + \frac{B}{\lambda^2-y}$$

were obtained.

These values are listed in the following table

Substituent	A	x	B	y
H	85	.070	30	.104
Cl	114	.070	38	.104
Br	114	.070	38	.104
I	117	.070	38	.104
OCH <sub>3</sub>	125	.070	50	.104
NO <sub>2</sub>	111	.085	38	.104
NH <sub>2</sub>	186	.075	100	.104

Rotatory dispersion data are also reported for other amide derivatives of  $\alpha$ -phenylethyl amine.

Part II. A series of alcohols and ketones were reduced using lithium aluminum hydride and aluminum chloride in a 3:1 ratio. By varying the solvent for the reaction and the temperature of the reaction a number of alcohols and ketones, previously resistant to reduction, were taken to hydrocarbons. Microfilm \$2.50; Xerox \$5.80. 120 pages.

#### STUDIES ON MOLECULAR ELECTRONIC TRANSITIONS

(L. C. Card No. Mic 60-4199)

Jean Philip Paris, Ph.D.  
Purdue University, 1960

Major Professor: Warren W. Brandt

#### Electronic Transitions in Amino-N-Heterocycles

The importance of intramolecular charge transfer transitions in aminopyridines and aminoquinolines was



demonstrated by solvent and protonation shifts for their absorption spectra. The charge transfer transition observed was given the notation  $2p(\text{NH}_2)\text{-pi}^*$  and represents the excitation of a 2p electron of the amino group to an antibonding pi orbital.

The aminopyridines and 3- and 8-aminoquinoline were studied in the neutral form in cyclohexane, the monoprotonated form in acidic aqueous solution and the diprotonated form in concentrated sulfuric acid. Their spectra were interpreted on the basis of the previously recognized  $n\text{-pi}^*$  and  $\pi\text{-pi}^*$  transitions and the newly recognized  $2p(\text{NH}_2)\text{-pi}^*$  transitions.

#### Charge Transfer Transitions in Metal Chelates

The assignment of the ruthenous polyamine chelate luminescence to a  $^3\pi^*\text{-d}$  charge transfer transition was the first of its kind to be noted for transition metal chelates. The ruthenous chelates have sufficient ligand field splitting so that the energy for the d-d absorption band is higher than that for the  $d\text{-pi}^*$  charge transfer transition. Since luminescence takes place from the lowest energy transition, only  $^3\pi^*\text{-d}$  emission is observed. The emitting excited state has been shown to be a triplet by theoretical consideration of spin-orbit coupling in the presence of heavy atoms, and by the experimental observation of an "allowed"  $d\text{-}^3\pi^*$  absorption band.

On the basis of the luminescence noted for the ruthenous chelates an analogous charge transfer luminescence was predicted and found for the cuprous pyridine complexes. For these complexes there were no d-d transitions possible since the 3d electronic shell is filled. The long wavelength absorption band leading to luminescence was the  $d\text{-pi}^*$  transition involving excitation of a 3d cuprous electron to the  $\pi^*$  orbital of pyridine. The fluorescent perchlorate, iodide and bromide salts of mono-pyridine copper(I) were isolated for the first time.

#### Electronic Transitions in 8-Hydroxyquinoline

Fluorescence of sodium oxinate in relatively noninteracting solvents such as acetone and dimethylformamide was observed. This fluorescence proved that the energies of the  $n\text{-pi}^*$  and  $\pi\text{-pi}^*$  transitions are inverted for 8-hydroxyquinoline in going from the nonfluorescent neutral molecule, having a long wavelength  $n\text{-pi}^*$  transition, to the highly fluorescent ionized species, having a long wavelength  $\pi\text{-pi}^*$  transition.

Water was found to be a potent quenching agent for the sodium oxinate luminescence. A stable hydrate was postulated as being the intermediate causing electronic deactivation.

#### Comparison of Pi Energy Levels in Nitrogen Heterocycles

The comparison of energy levels between molecules is of prime importance in understanding both the spectra and chemistry of series of molecules. The method described for nitrogen heterocycles involves the use of the "internal standard" nonbonding electron energy levels. The energy levels for the nonbonding electrons in nitrogen heterocycles are considered to be equivalent provided the pi electron densities at the nitrogen atoms for the molecules being compared are equivalent.

Using this "internal standard" method, the effects on the  $\pi^*$  energy levels of nitrogen heterocycles for additional ring nitrogen atoms, increased ring conjugation and halogen substitution have been calculated and discussed.

Microfilm \$3.40; Xerox \$11.95. 262 pages.

#### THE CHELOMETRIC END POINT: A KINETIC AND EQUILIBRIUM STUDY.

(L. C. Card No. Mic 60-4864)

Donald Warren Rogers, Ph.D.  
The University of North Carolina, 1960

Supervisor: Charles N. Reilley

Although the theory of the chelometric end point is formally similar to the theory of the acid-base end point, its application is more difficult owing to three factors:

1. Metallochromic indicators, used in the visual chelometric end point, are often impure and may be rendered useless by impurities either in themselves or in other reagents.
2. Common chelons and metallochromic indicators are polybasic acids vastly increasing the mathematical detail in the calculation of suitable titration conditions.
3. The kinetics of chelate exchange are often much slower than acid-base reactions making the end point drag or, in some cases, altogether preventing the observation of an end point.

The present work consists of three parts. First, a method for the determination of the purity of metallochromic indicators has been worked out and applied to samples of several different kinds of metallochromic indicators. Using different titrants under different conditions, different kinds of impurities can be detected and classified. Results for ten indicator samples are shown and interpreted.

Second, after purification of Erio dyes by a modification of a method described in the literature, the variation of the effective equilibrium constant of the exchange reaction between copper-Erio R complexes and EDTA was studied. The effective equilibrium constant was defined as the equilibrium constant as measured disregarding the several changes in reactant species which take place as the pH is changed. The effective equilibrium constant is a composite function which includes the true equilibrium constants of the protonated species which predominate at various pH values.

Having worked out the simultaneous equilibria involved between Erio R and EDTA, a kinetic study was made at pH values ranging from three to twelve. Both the forward and back reactions were studied by the limiting slope method. Both were found to be second order reactions over the whole pH range. Activation energy, salt effects, and buffer effects were studied and evaluated. Each reaction proceeds by four main reaction paths. Mathematical techniques are given for the evaluation of the simultaneous rate constants and they are related to the observed data. Results are given for the kinetics of exchange of three indicators which are very much like Erio R but differ in some small detail of structure. The kinetics of exchange were also studied for the reaction of copper Erio R complex

with three chelons which are similar to EDTA but differ somewhat in molecular structure.

On the basis of the collected experimental evidence, a mechanism is proposed which involves the formation of a reactive intermediate in small steady state concentration by the dissociation of one or more (but not all) of the coordination sites of the attacked species, the copper complex. After formation of the reactive intermediate, the complex exchange takes place by bimolecular collision with the attacking molecule. A discussion is included relating all of the experimental data with the proposed mechanism.

The third part of the study is the application of the techniques and knowledge gained in the first two to the problem of the ultramicro determination of calcium and magnesium in mixtures. A short discussion is given to show why a conventional approach to the problem will be unsuccessful. A back titration technique is proposed which involves the stepwise displacement of calcium and magnesium from their EGTA complexes by zinc titrant. The end point is determined spectrophotometrically. Optimum titration conditions are stipulated by application of the methods already described for handling simultaneous equilibria.

Results are given at concentrations as low as  $4 \times 10^{-6}$  M. The error at this concentration is about one percent. By a modification of the experimental technique, samples as small as 0.5 micrograms are reported to an accuracy of 0.05 micrograms.

Microfilm \$2.50; Xerox \$5.00. 97 pages.

THE COPPER(II) DERIVATIVES OF  
S-(1,2-trans-DICHLOROVINYL)-L-CYSTEINE  
AND RELATED COMPOUNDS.

(L. C. Card No. Mic 60-4909)

Harry Whitney Wharton, Ph.D.  
Iowa State University of Science and Technology, 1960

Supervisor: Harvey Diehl

S-(1,2-trans-dichlorovinyl)-L-cysteine has been reported as the possible toxic factor in trichloroethylene-extracted soybean oil meal (1) and the cause of fatal aplastic anemia in calves (2).

Investigations into the reactivity of this material toward normal physiological cations showed a reaction only with copper(II). Copper(I), iron(II), manganese(II), chromium(III), cobalt(II), nickel(II), molybdenum(III), tin(II), lead(II), zinc, cadmium, aluminum, or the alkaline earths failed to react. Some reaction was noted with silver and mercury(II) but was not investigated further.

Copper(II) and S-(1,2-trans-dichlorovinyl)-L-cysteine unite to form a 1:2 pale blue compound extremely insoluble in water. The solubility of this compound was determined in acetate and maleate buffer systems from pH 3 to 7 and the solubility product constant expression was derived containing factors correcting for pH dependency and competitive complexing of copper(II) by the buffer system anion. The reported solubility product constant is  $9.70 \times 10^{-20}$  at  $25^\circ$ .

The solubility of this copper(II) derivative in bovine blood serum was 32.6 mg. per 100 ml. compared to 0.026 mg. per 100 ml. of water corrected to a comparable pH and both at  $25^\circ$ . Thus the toxicity of the S-substituted L-cysteine derivative is not likely due to a physical removal of the physiological copper as the insoluble complex. Dialysis studies indicated that S-(1,2-trans-dichlorovinyl)-L-cysteine in bovine blood serum was dialyzable against water. Less than one percent of the copper dialyzed, whether introduced into the serum as the copper(II) derivative or as copper(II) nitrate at the same copper level.

Unsuccessful attempts were made to prepare an electrode, by electrodeposition of the copper(II) derivative, which would be sensitive to the concentration of the S-(1,2-trans-dichlorovinyl)-L-cysteinate anion.

In addition to S-(1,2-trans-dichlorovinyl)-L-cysteine, 1,2-bis-(S-L-cysteine)ethane and S-(1,2-trans-dichlorovinyl)- $\beta$ -mercaptopropionic acid were prepared. The copper(II) derivatives of these compounds and of 1,2-bis-(S-L-cysteine)ethylene, L-cystine, djenkolic acid, glycine, and S-cyclopentane-L-cysteine, as well as the copper(I) derivative of L-cysteine, were prepared and analyzed.

The infrared absorption spectra of these copper derivatives and of their parent organic acids are reported. With glycine and the S-substituted L-cysteine derivatives, covalent bonding takes place through the amino group and ionic bonding exists at the carboxylate group. The only isolable copper compound of L-cysteine was the black 1:1 copper(I) derivative with bonding taking place only through the sulfur atom.

1. McKinney, L. L., Picken, J. C., Jr., Weakley, F. B., Eldridge, A. C., Campbell, R. E., Cowen, J. C., and Beister, H. E. J. Amer. Chem. Soc. 81:909 (1959).
2. *Ibid.*, 79:3932 (1957).

Microfilm \$2.50; Xerox \$5.00. 100 pages.

CHEMISTRY, BIOLOGICAL

THE ISOLATION OF  
PHOSPHOGLUCOSE ISOMERASE

(L. C. Card No. Mic 60-5388)

Annette Sudman Baich, Ph.D.  
University of Oregon, 1960

Adviser: F. J. Reithel

Phosphoglucose isomerase, which catalyzes the interconversion of glucose-6-phosphate and fructose-6-phosphate, has been isolated in homogeneous form from a mammalian source, bovine lactating mammary tissue. The isolation involves selective extraction of the enzyme from the tissue, successive treatments with anion and cation exchange materials, treatment with calcium phosphate, and preparative electrophoresis. Although phosphoglucose isomerase composes only 0.02% of the soluble protein in this tissue, the isolation procedure is rapid and



effective, and a 15% yield of homogeneous enzyme is obtained. Phosphoglucose isomerase appears to be a simple, relatively low molecular weight protein with a turnover number of 35,000 moles fructose-6-phosphate formed per minute per mole enzyme.

Microfilm \$2.50; Xerox \$3.00. 46 pages.

# ACTION OF HYPOCHLORITE AND CHLORINE ON PLANT POLYSACCHARIDES

(L. C. Card No. Mic 60-6095)

Alan Michael Belfort, Ph.D.  
Purdue University, 1960

Major Professor: Roy L. Whistler

Xylan, a product isolated from corn cobs, was oxidized with 3.5 and 7.0 equivalents of aqueous sodium hypochlorite solution at pH levels of 3, 5, 6, 7, and 9. The rates of oxidation were most rapid in acid and neutral media. When the oxidation is performed at pH 7 with 3.5 equivalents of hypochlorite, 36.0 per cent of the hypochlorite is converted to chlorate.

The products, isolated after dialysis and acid hydrolysis, were identified as follows: D-xylose as dibenzylidene dimethyl acetal; D-glyceric acid, as the brucine salt, as the calcium salt and by X-ray diffraction pattern. The amounts of products, when 3.5 equivalents of sodium hypochlorite were used, at pH 6, were 41 mole per cent D-xylose, determined by hypiodite oxidation, 11 mole per cent D-glyceric acid, determined colorimetrically with 1, 3-naphthalenediol in sulfuric acid solution and 15 mole per cent carbon dioxide, determined by differential titration of sodium hydroxide solution. Oxidation with 7.0 equivalents of sodium hypochlorite produces increased amounts of D-glyceric acid and decreased amounts of D-xylose.

Oxidation of amylopectin, isolated from corn starch, with 3 equivalents of chlorine water at 25° and 60°, proceeded most rapidly at pH 7 and pH 5, with slower rates at pH 9 and pH 1.8. The main products, isolated after dialysis and acid hydrolysis of the oxidation solutions, were identified as follows:  $\alpha$ -D-glucose, as crystals, and as  $\alpha$ -D-glucosephenylhydrazones; D-glyceric acid, as the brucine salt, and by X-ray diffraction pattern and infrared pattern. In addition to these, D-erythroneolactone, isolated as crystals, calcium oxalate, identified by color reactions and D-arabinose were also produced.

The amounts of products at pH 1.8 were 42 mole per cent D-glucose, determined by hypiodite oxidation, 32 mole per cent D-glyceric acid, determined colorimetrically with 1, 3-naphthalenediol in sulfuric acid, and 4 mole per cent carbon dioxide, determined by differential titration of sodium hydroxide solution. The amounts of products at the other pH levels were similar.

Microfilm \$2.50; Xerox \$3.60. 65 pages.

# THE METABOLIC FATE OF SOME PHENOLIC COMPOUNDS IN THE RAT

(L. C. Card No. Mic 60-5184)

Hugh Douglas Braymer, Ph.D.  
The University of Oklahoma, 1960

Major Professor: Simon H. Wender

Since coumarin and flavonoid compounds are widely distributed in nature, the consequent intake of certain of these compounds in foods, cigarette smoke and some pharmaceuticals leads to an interest in the metabolism of the compounds.

Using paper chromatographic techniques, the urinary metabolites of scopoletin, esculetin and esculin and the metabolism of quercetin were studied. Of related interest to these studies was the identification of the quercetin methyl ethers isolated from tobacco.

The synthesis of scopoletin from esculin via benzylolation, as described in this dissertation, is the first method reported that will give an over-all yield high enough to make the synthesis of large amounts of this compound practical.

The solution of the synthesis problem made possible the study of the urinary metabolites of scopoletin. The metabolites identified from rats fed scopoletin were esculetin, unchanged scopoletin, scopoletin glucuronide and scopoletin sulfate. The finding of esculetin as one of the metabolites was quite unexpected since demethylation of phenolic ethers in biological systems has not been previously proved.

The investigation as to the urinary metabolites produced when animals are fed esculetin and esculin resulted in the identification thus far of scopoletin, 6-hydroxy-7-methoxycoumarin, esculetin sulfate, 6-hydroxy-7-methoxycoumarin sulfate and esculetin glucuronide.

Administration of quercetin to rats resulted in the excretion of numerous phenolic breakdown products. The compounds identified were 3, 4-dihydroxyphenylacetic acid, m-hydroxyphenylacetic acid, m-hydroxycinnamic acid, m-hydroxyphenylpropionic acid, vanillic acid, homovanillic acid, and tentatively, m-hydroxybenzoic acid. A neutral compound was isolated and characterized as an o-dihydroxy lactone; it may be the key to what happens to the phloroglucinol portion of the molecule.

The appearance of 5, 7, 3', 4'-tetramethylquercetin in the urine of an animal fed this compound is proof of absorption of the intact molecule in at least that one instance. The absence of phenolic acids in the above case led to the assumption that to have breakdown, certain of the hydroxy groups of quercetin derivatives must be free.

The experiments with gastric mucin strongly indicated that the breakdown of quercetin which took place was not an enzymatic reaction. The breakdown was much too slow and the active fraction was dialyzable. Experimentation with tied-off animal stomachs proved rather conclusively that quercetin breakdown did not occur in the stomach under the experimental conditions used.

Two quercetin methyl ethers isolated from tobacco were characterized. One of them was identified conclusively as the 3, 3'-dimethyl ether of quercetin. The other was tentatively identified as the 3-methyl ether of quercetin.

Microfilm \$2.50; Xerox \$4.20. 77 pages.



INFLUENCE OF MAGNESIUM DEFICIENCY  
ON SELECTED ASPECTS OF  
PROTEIN METABOLISM

(L. C. Card No. Mic 60-5875)

Evelyn May Cox, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: Dr. Charlotte Roderuck

Although the need of animals for magnesium was conclusively established in 1932, the mechanism through which magnesium functions *in vivo* has not been clearly defined. This study examined the relationship of magnesium deficiency to selected aspects of protein metabolism in albino rats.

In a preliminary experiment, diets containing 19 per cent or 28 per cent casein, with and without the addition of magnesium, and 2.1 per cent salt mix were fed. Growth and food efficiency were studied until the 84th day when viscera were inspected for pathological changes and serum samples were obtained for nitrogen, protein distribution and magnesium measurements.

In the second and again in the third experiments, differences between quantities of protein in the diets were increased by using casein concentrations of 14 per cent and 28 per cent. The amount of mineral mix was increased to 3.8 per cent in order to control diarrhea which had developed on the 2.1 per cent salt intake.

Growth and food efficiency were studied, in the second experiment, and in addition, nitrogen balances were obtained while the rats were hyperemic and in the period immediately following hyperemia. Total serum nitrogen, serum magnesium and hepatic nitrogen were measured in animals sacrificed on the 28th and 42nd experimental day.

Data obtained in the third experiment, after 10 days of feeding the experimental diets to rats, included hepatic nitrogen determinations, packed red blood cell volumes, hemoglobin concentrations and relative proportions of the various blood proteins after separation on paper by electrophoresis, serum nitrogen and magnesium concentrations, hepatic and serum glutamic-oxalacetic and glutamic-pyruvic transaminase activities.

Absence of magnesium from the diet caused a highly significant decrease in serum magnesium by the 10th experimental day. Deficient animals developed classical symptoms of vasodilation and hyperemia followed by a period of hyperexcitability, and pathological changes were observed in kidneys and hemorrhages were sometimes present in the lungs and intestinal tract.

Magnesium deficiency influenced protein metabolism by (1) decreasing nitrogen retention, food efficiency and weight gain per gram of nitrogen retained, thus preventing as good a rate of growth as seen with control animals, (2) causing a decrease in total serum nitrogen and in proportion of serum albumin, and (3) preventing an increase of serum gamma-globulin as animals grew older.

Hemoglobin concentrations, serum glutamic-oxalacetic transaminase and glutamic-pyruvic transaminase activities and hepatic glutamic-oxalacetic transaminase activities were not influenced by 10 days of magnesium deprivation nor by quantity of casein in the diet.

Microfilm \$2.50; Xerox \$6.40. 133 pages.

I. METAL-PYRIDOXAL-AMINO ACID CHELATES.  
II. STUDIES ON THE PURIFICATION AND  
KINETICS OF THREONINE DEHYDRASE.

(L. C. Card No. Mic 60-5876)

Leodis Davis, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: David E. Metzler

The formation of metal chelates of imines derived from pyridoxal plus alpha amino acids in aqueous solutions has been studied. It was shown that with Cu (II) and Ni (II) the principal chelates formed contain the metal, pyridoxal, and amino acid in a 1:1:1 ratio. The composition of the copper chelates were demonstrated by isolation and analytical determination; the composition of the nickel chelate was obtained from the fact that the formation constant was unchanged when a 1:1:1 ratio was assumed.

These chelates accept protons on the ring nitrogen with  $pK_a$  of 5.6 for the copper-pyridoxylidene-valine 6.05 for the copper-pyridoxylidene-glycine and 6.7 for the nickel-pyridoxylidene-valine compound. The protonated form of the copper-pyridoxylidene-valine chelate was prepared and isolated as the hydrochloride.

From absorbancy vs. pH data, formation constants (K) were determined for the chelates and found to be pH dependent.

A plot of log K vs. pH indicated that the chelates do accept single protons and gave an independent determination of  $pK_a$ . The pH independent constant ( $K_c$ ) for the imine dianion plus divalent metal reacting to form neutral chelate was obtained from log K vs. pH graphs and found to be 14.5 for copper-pyridoxylidene-valine, 15.0 for copper-pyridoxylidene-glycine and 10.8 for nickel-pyridoxylidene-valine.

The enzyme threonine dehydrase has been obtained in highly purified form by use of heat treatments (70°C) ammonium sulfate precipitation and diethylaminoethyl cellulose chromatography, finally reaching a specific activity of 0.2 millimoles alpha-ketobutyrate formed per hour per milligram protein. The enzyme is stable over the pH range 5 to 9, permitting a study of the variation of the Michaelis constant and maximum velocity in this pH range without enzyme inactivation.

The maximum velocity at substrate saturation does not change over the pH range 5.5 to 9. In contrast, the Michaelis constant is highly pH dependent, with a minimum value in the pH range 8.5 to 9, consistent with a binding of the threonine anion to the enzyme in a form containing two protonated groups at the active site.

Glycine was found to competitively inhibit threonine dehydrase and the variation of the inhibitor constant with pH was consistent with the conclusions drawn from the variation of the Michaelis constant with pH. Carbonyl reagents (hydroxylamine, semicarbazide) also inhibited the enzyme and were found to inhibit more effectively at pH 9 and above than at lower pH values; at pH 9 and above the inhibition is competitive. Cyanide does not inhibit. The inhibitor constants are  $5.2 \times 10^{-7}$  and  $7.7 \times 10^{-4}$  M at pH 9 for hydroxylamine and semicarbazide respectively; the Michaelis constant at this pH is  $5.3 \times 10^{-4}$  M.

It has not been possible to resolve the enzyme into pyridoxal phosphate and apoenzyme. Furthermore, no



maxima occur in the spectra of the most highly purified preparations in the region where pyridoxal phosphate would be expected to absorb.

The most highly purified enzyme shows activity towards L-threonine, L-serine and DL-(allo) threonine. When serine is used as a substrate at pH 7 there is an initial burst of pyruvate production which terminates after 10 minutes with no further reaction. At pH 9 the same initial burst occurs; however, after this rapid production of pyruvate the reaction continues for up to two hours at a slower rate. Threonine dehydrase has maximal activity in the presence of potassium, sodium, or ammonium ions.

Microfilm \$2.50; Xerox \$5.80; 119 pages.

#### NATURE OF THE FORSSMAN HAPTEN FROM SHEEP ERYTHROCYTE STROMA

(L. C. Card No. Mic 60-5427)

John Edwin Diehl, Ph.D.

The Pennsylvania State University, 1960

Following the discovery of the Forssman antigen in 1911, many studies have been carried out in an effort to more fully recognize the chemical nature of the hapten portion of this antigenic complex. The divergence of the early findings on this heterogenetic substance has been attributed mostly to the use of preparations of questionable purity. An improved method of isolation was needed to further the characterization of the hapten by establishing the nature of the hydrolytic components and to shed light on the manner in which they are chemically linked.

In this study, solvent fractionation, cellulose column and paper chromatographic methods were examined for the purification of the Forssman hapten from sheep erythrocyte stroma. The purified material obtained by solvent fractionation was found to be soluble in such solvents as methanol, water and pyridine, but not in ether, chloroform or acetone. This white, non-hygroscopic powder melted with decomposition at 203°C. after browning over a wide temperature range of 155-191°C. It contained 2.8% nitrogen, less than 0.1% phosphorus, 11.5% hexosamine and 31.6% hexose (Corrected for hexosamine). The unhydrolyzed hapten was analyzed quantitatively for hexose and gave a zero value, indicating that the reducing groups were not free in the intact molecule.

Upon acid hydrolysis the hapten yielded fatty acid, basic and neutral fractions. The fatty acid fraction was examined by reversed phase paper chromatography and found to contain lignoceric acid along with smaller amounts of nervonic, stearic and palmitic acids. The basic fraction showed the same chromatographic behavior as a pure sample of sphingosine. The neutral fraction was composed mainly of galactose and galactosamine accompanied by detectable amounts of glucose and glucosamine.

Microfilm \$2.50; Xerox \$3.00. 46 pages.

#### POOL SIZES OF THE ADENINE NUCLEOTIDES OF *ESCHERICHIA COLI* B AS A FUNCTION OF GROWTH RATE

(L. C. Card No. Mic 60-5308)

James Stephen Franzen, Ph.D.

University of Illinois,

Chicago Professional Colleges, 1960

The objective of the present study was to establish quantitatively the levels of the nucleotides of the acid-soluble fraction of *E. coli* under various conditions of balanced growth. Variations in the nucleotide profile could possibly have been interpreted in terms of known metabolic mechanisms.

The culture of *E. coli* strain B was maintained on nutrient agar slants, and was transferred to a fresh slant every two to four weeks. For the growth experiments media were chosen which would sustain different generation rates. The results could then be expressed in relation to growth rate. On a minimal salts medium with Na lactate as a carbon source the generation time was 0.73 doublings/hr. The fastest rate of 2.4 doublings/hr. was obtained with a medium of 1.5% casamino acids plus yeast extract plus malt extract. It was determined that 1.0 ml. of culture at an O.D. of 1.0, as measured in the Beckman DU spectrophotometer at 450 m $\mu$ , corresponded to 0.317 mg. dry wt. Viable counts were also determined as the cells grew in the various media and thus the mass per cell could be calculated. It was found that mass per cell was an exponential function of the growth rate as expressed in doublings per hour.

When the log phase culture, about 1 liter in volume, reached an O.D. of 0.8, 500 ml. was removed into a chilled flask. Immediately 500 ml. of fresh medium was added to the remaining culture. The O.D. therefore was then reduced two-fold and the culture was thus maintained in exponential phase. The 500 ml. of chilled culture was immediately filtered employing a millipore bacterial filter with a pore size of 0.45  $\mu$ . The cells were washed with saline, isotonic with growth medium, and extracted with cold perchloric acid. This procedure was repeated when the growing culture again reached an O.D. of 0.8. The combined perchloric acid extract represented about 1.0 gm. dry wt. of cells.

The extract was assayed for ATP by the firefly luciferase method and was then subjected to chromatographic resolution on Dowex-1 resin using the formic acid-ammonium formate elution procedure. The eluate fractions obtained were identified by 1) comparison with the breakthrough position of a column bearing a simple mixture of known compounds; 2) superimposing the radioactivity profile onto the absorbance profile when known radioactive compounds were resolved along with the perchloric acid extract; 3) subjecting the fractions in question to paper chromatography; and 4) comparing elution profiles with published results. The fractions were quantitated by taking the area under the plot of absorbancy vs. tube number and employing the extinction at 260 m $\mu$ .

It was found that the ratio of ATP:ADP:AMP under all conditions of growth was about 100:12:2. The variation of ATP per cell and of the combined GTP-UTP fraction per cell with growth rate expressed in doublings per hour was exponential. The molar concentration of ATP, however,

did not change with growth rate. In a medium of 15% sucrose and glucose-minimal salts the mass per cell was one half that obtained in a simple glucose-minimal salts medium. In this case the molar concentration of nucleotides was increased, however, so that the content per cell was the same as that for a minimal salts medium. Growth upon casamino acids brought about the extracellular accumulation of an unknown nucleotide which came off the formate column immediately after AMP.

Microfilm \$2.50; Xerox \$3.80. 67 pages.

THE USE OF GAS CHROMATOGRAPHY  
TO STUDY VOLATILE SUBSTANCES IN  
UNPROCESSED WHOLE BLOOD, WITH SPECIAL  
REFERENCE TO VOLATILE COMPOUNDS  
IN THE BLOOD OF EWES  
DURING PREGNANCY TOXEMIA.

(L. C. Card No. Mic 60-6111)

Richard Wilson Hughes, Ph.D.  
Purdue University, 1960

Major Professor: Gerald D. Goetsch

While the generally accepted "ketosis" theory of ovine pregnancy toxemia has greatly increased our understanding of this disease, there has been little evidence offered to indicate that the ketosis commonly reported is in any way related to the clinical signs of the disease. In order to approach this problem from a different vantage, gas chromatographic studies were made of the blood of ewes during pregnancy toxemia, with the possibility that a clue to the cause of the clinical disease might be found.

Preliminary studies were made to find:

1. A satisfactory gas chromatographic column to analyze blood gasses and volatiles.

Nine columns were studied to find one that would most satisfactorily separate the components of a test mixture. This mixture contained many of the possible gasses and short-chain volatile liquids that might be present in the blood of ruminants. Carbowax 1540 on 80-100 chromosorb was found to be the most satisfactory for the analysis.

2. A method of analyzing unprocessed whole blood so that the results obtained would not be invalidated by physical and chemical manipulations of the sample before the injection into the chromatograph.

This problem was approached by constructing a high temperature trap into which samples of whole blood were injected. The volatile components were vaporized in this trap and swept by the carrier gas directly into the chromatograph for analysis. Thus, there was no loss or dilution of components by deproteinization or steam distillation of the samples. The solid components of the blood samples were retained in the trap. As many as twenty samples could be analyzed before cleaning of the trap was necessary.

3. A method of eliminating the interference to gas chromatographic analysis caused by the large amounts of water in the sample. The water peak obscured an enormous area of the chromatographic tracings, and greatly increased the total time of analysis.

This problem was solved by completely burning the

volatile components of the sample into carbon dioxide and water after column separation. The water was then removed by a refrigerated silica gel drying column. The carbon dioxide, which represents the separated organic components, continued through the drying column practically undisturbed and was detected in the standard manner.

These techniques were applied to the study of whole blood of ewes during clinical pregnancy toxemia and to ewes during starvation-induced pregnancy toxemia. Four components were consistently found in the blood of these animals: methane, carbon dioxide, acetaldehyde, and acetone.

Only acetone appeared to be correlated with the clinical disease. A sharp increase in blood acetone to levels of 15 milligrams percent or higher occurred simultaneously with the onset of clinical signs in affected animals. In non-affected ewes the increase was either slight or completely absent.

The effect of dietary protein and carbohydrate on the occurrence of the disease was also examined in these experiments, but the number of clinical cases of pregnancy toxemia in the experimental flock were too few to indicate a significant relationship.

Microfilm \$2.50; Xerox \$4.80. 94 pages.

THE PURIFICATION OF GLUCOSE-6-PHOSPHATE  
DEHYDROGENASE FROM AN EXTRACT  
OF BOVINE MAMMARY GLAND

(L. C. Card No. Mic 60-5395)

Gordon Ray Julian, Ph.D.  
University of Oregon, 1960

Adviser: F. J. Reithel

As its name suggests, glucose-6-phosphate dehydrogenase is an enzyme which participates in a biochemical reaction which removes hydrogen atoms from glucose-6-phosphate. The product of this reaction is 6-phosphogluconate. The enzyme is a member of a group of dehydrogenases which act in conjunction with one or both of the so-called pyridine nucleotide coenzymes, namely di- and tri-phosphopyridine nucleotides (DPN and TPN, respectively). As the substrate is oxidized during the enzymic reaction, the appropriate coenzyme is reduced in an equivalent amount. On reduction, these coenzymes exhibit a substantial increase in their absorption of ultraviolet light at 340 m $\mu$ . This phenomenon permits a convenient means for spectrophotometric estimation of the corresponding substrates provided that the reaction proceeds to completion in a quantitative manner. Obviously, when enzymes are used as analytical implements, they must be of sufficient purity to obviate possible interference by other related enzymic reactions.

Glucose-6-phosphate dehydrogenase obtained from mammalian sources belongs to the class of dehydrogenases which specifically requires the presence of TPN for its activity. The enzymic oxidation of glucose-6-phosphate essentially goes to completion in basic medium or when either the TPN or glucose-6-phosphate are in excess of the other. Our laboratory has shared with other groups an interest in this enzyme for analytical purposes.



Although this analytical interest constituted sufficient reason (or if you prefer, excuse) for the purification of the enzyme, there existed, as well, a more basic motivation, common to the ambitions of most biochemists, which is directed toward understanding, in purely chemical terms, the structural basis for an enzyme's performance. Since so few enzymes have been isolated to date, it is unlikely that the most convenient enzymes for such studies are presently available. Each protein purification which is conducted contributes to this quest if only by furnishing new purification techniques to hasten the search for the most suitable enzymes.

From an extract of cow udder, glucose-6-phosphate dehydrogenase was purified by a factor of  $10^4$ . The methods used for purification were based on conventional protein purification techniques but altered in a fashion to permit the processing of large amounts of protein. The methods include:

- (1) hypotonic extraction
- (2) alcohol fractionation
- (3) ammonium sulfate fractionation
- (4) zinc fractionation
- (5) hydroxylapatite chromatography
- (6) DEAE-cellulose chromatography
- (7) desalting by the use of Sephadex

An initial instability was subdued, although not entirely eliminated, by the use of thioglycollate in the buffers employed.

The purified enzyme could not be shown to be homogeneous on examination in an ultracentrifuge. However, it was obtained in a crystalline precipitate which suggests a high degree of purity. Its instability and/or its insolubility in the highly purified state may have contributed to its heterogeneity. The purification, at any rate, was well beyond that required for analytical purposes.

It is hoped that what has been accomplished will ultimately lead to an unequivocal isolation of this enzyme to allow its physical and chemical characterization.

Microfilm \$2.50; Xerox \$4.40. 84 pages.

#### SPECIFICITY STUDIES OF HEXOKINASES

(L. C. Card No. Mic 60-5312)

Charles Ford Lange, Jr., Ph.D.  
University of Illinois,  
Chicago Professional Colleges, 1960

This investigation was undertaken initially to determine whether the rare aldohexoses, D-allose, D-altrose, D-gulose, D-idose and D-talose, were substrates for, or inhibitors of, various hexokinases. Later this work was expanded to include studies of D-glucosamine, N-acetyl-D-glucosamine, and 2-deoxy-D-glucose. Yeast hexokinase and hexokinases prepared from beef brain, rat intestine, rat kidney, rat liver, Ehrlich's ascites tumor cells, Jensen sarcoma, Walker carcinoma and a spontaneous adenocarcinoma were studied.

A constant pH microtitrimetric method of assay was used (1). The following results were obtained.

1. Allose was a substrate for all enzyme systems studied except that from Jensen sarcoma.

2. Altrose was a substrate only for the yeast, brain, spontaneous adenocarcinoma and Walker hexokinase preparations.
3. Gulose was a substrate only for liver, Ehrlich's ascites cell, spontaneous adenocarcinoma and Walker hexokinase preparations.
4. Idose was not a substrate for any of the enzyme systems.
5. Talose was a substrate for all the hexokinase preparations except that of Ehrlich's ascites cell and Jensen sarcoma.
6. Glucosamine was a substrate for all the hexokinase preparations except that of Ehrlich's ascites cell.
7. N-Acetylglucosamine was found to be a substrate only for the enzyme preparations from brain, Jensen sarcoma and Walker carcinoma.
8. 2-Deoxyglucose, like glucose, was a substrate for all the hexokinase preparations.

These results showed that considerable range of specificity in the enzyme preparations existed, varying from the very specific glucokinase in Jensen tumors to the quite non-specific hexokinase activity in Walker tumors.

Competitive inhibition of glucose phosphorylation was observed in a number of instances. Yeast hexokinase was inhibited by altrose, idose and N-acetylglucosamine; beef brain hexokinase was inhibited by idose; and Ehrlich's ascites cell hexokinase was inhibited by altrose and talose. No competitive inhibition of any of the other enzyme preparations studied was observed with any of the carbohydrates.

From the behavior of the enzyme systems studied it appears that the configuration of the hydroxyl groups at carbon atoms 3, 4 and 6 are important binding sites, and determine whether or not the carbohydrate will act as a substrate. The configuration, or structure, at carbon atom 2 plays little role in this behavior. If the configuration at carbon atom 3 is opposite to that of glucose, some activity is lost. Changes in configuration at atoms 3 and 4, or 3 and 2 caused the loss of activity of most of the enzyme systems. Changes in configuration at carbons 2, 3 and 4 resulted in loss of activity of all the enzyme systems studied.

Although the configuration at carbon atom 2 had little significance in the behavior of the substance as a substrate, it is of interest to note that in all cases where inhibition was observed, the configuration at carbon atom 2 was opposite to that of glucose.

- (1) Schwartz, M., Myers, T. C.: Simple Microtitrimetric Constant pH Method for Accurate Enzyme Assays. *Anal. Chem.*, 30, 1150 (1958).

Microfilm \$2.50; Xerox \$6.00. 123 pages.

**ISOLATION OF NEURAMINIDASE FROM  
INFLUENZA A VIRUS**

(L. C. Card No. Mic 60-5313)

Lewis Walter Mayron, Ph.D.  
University of Illinois,  
Chicago Professional Colleges, 1960

An assay procedure for the neuraminidase activity of influenza virus has been developed employing as substrate glycoprotein derived from plasma or milk. Incubation is followed by precipitation of the proteins with phosphotungstic acid and sialic acid analysis of the supernatant solution.

Non-dialyzable, enzymatically-active material was split from PR8 influenza virus by treatment with trypsin at neutral pH and was separated from the remainder of the virus particles by ultracentrifugation. The virus was obtained from virus-infected chorioallantoic fluid; moreover, normal chorioallantoic fluid was found not to contain neuraminidase activity. The protein nature of this enzyme material was indicated by its non-dialyzability and the destruction of its activity by incubation with chymotrypsin. Seventy to ninety per cent of total protein present was found in the enzymatically-active fractions obtained by both ammonium sulfate and methanol fractionation procedures. Thus, the enzyme is not yet pure.

The neuraminidase is stable to dialysis against salt solutions and comparatively small volumes of distilled water. Its activity is destroyed by precipitation with acetone, the presence of glutathione and/or merthiolate in the reaction mixture or incubation at alkaline pH.

The enzyme solution does not agglutinate erythrocytes, nor does it block their agglutination by an added dose of indicator virus. It destroys the receptor sites on erythrocytes for LEE indicator virus. The possibility of the presence on the virus particle of different sites for the functions of enzymatic activity and hemagglutination is discussed.

Basic kinetic studies were performed using substrate obtained from dry skim milk.

Microfilm \$2.50; Xerox \$4.00. 73 pages.

**STUDIES ON PARTIAL REPLACEMENT  
OF DIETARY PROTEIN WITH  
CRYSTALLINE AMINO ACIDS**

(L. C. Card No. Mic 60-4929)

Donald Floyd Middendorf, Ph.D.  
University of Maryland, 1959

Supervisor: Dr. Gerald F. Combs

To determine the biological order of limitation of amino acids in practical-type rations it became necessary to design a mixture of amino acids which could be substituted for part of the dietary protein and maintain an optimum rate of gain. Corn-soybean oil meal chick starter rations were diluted with a corn starch, corn oil, mineral, and vitamin mixture to obtain protein-deficient diets having the same protein quality as the complete basal rations. As the Calorie:protein (C/P) ratio was widened from 42:1

to 120:1 (isocaloric protein levels of 23.7 and 8.2%, respectively) each level of dilution decreased the rate of gain and feed efficiency.

The amino acid requirements as listed by the National Research Council for 20% of dietary protein were assumed to have been determined through the use of rations which contained 900 Calories of productive energy per pound. These values were then converted to grams of amino acid required per therm of energy and all supplements were made on this basis. The suboptimal rate of gain which occurred when chicks received the moderately diluted rations was not improved by supplements of glutamic acid and all the essential amino acids to return them to 100% of adequacy; the inclusion of alanine, aspartic acid and proline in such supplements was not beneficial. The addition of isolated soybean protein to diluted rations returned the rate of gain to normal, but when its composition was approximated by crystalline amino acids the rate of gain was not improved above that of the negative control.

The supplementation of the lowest protein ration (C/P ratio of 120:1) with a mixture to return all essential amino acids to 65% of adequacy was partially effective, but the most efficacious supplements were those which were comprised of either 20.85, 30.0, or 41.7% of the requirement of each amino acid. Within a given mixture this percentage was constant for all amino acids and the glutamic acid level ranged from 1.5 to 4.0%. The development of these supplements was based upon the hypothesis that due to possible differences in rate of absorption the metabolism of the added crystalline amino acids may be partially independent of the metabolism of dietary protein. The rate of gain supported by a diluted ration (C/P ratio of 78:1, 15.49% protein) was returned to normal by such additions. The most effective supplement used was one composed of 41.7% of the requirement for arginine, lysine, methionine, tryptophan, glycine, valine, threonine, phenylalanine, leucine, and isoleucine, 166.8% of the requirement for histidine and a dietary total of 4% of glutamic acid. Whether or not these are the minimum supplemental levels has not been determined.

It has been demonstrated that at least 36% of the dietary protein in a practical-type chick starter ration can be replaced by crystalline amino acids. This partial replacement is sufficiently effective to permit studies regarding protein mixtures, single protein sources and/or crystalline amino acids, including the biological order of limitation of the essential amino acids in the basal ration.

Microfilm \$2.50; Xerox \$4.60. 87 pages.

**THE TISSUE DISTRIBUTION AND METABOLISM  
OF POLYXENYLPHOSPHATE  
IN TUMOR-BEARING MICE**

(L. C. Card No. Mic 60-5685)

Clara Anna Muehlbaeher, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor John P. Hummel

The synthesis of  $P^{32}$  and  $H^3$  labeled polyxenyolphosphate (PXP), by the action of  $P^{32}OCl_3$  on p-biphenol and subsequent hydrolysis of the polymeric acid chloride, is



described. Fractionation of the polymer on the basis of solubility in organic solvents and diffusability across dialysis casing resulted in several subfractions which differed little in their molecular weights but exhibited differences in equivalent weights, in ratio of secondary/primary protons of phosphate ester groups and in biphenyl and biphenol content.

Administration of fractions of PXP<sup>32</sup>, obtained by strong alkaline hydrolysis of the toluene insoluble portion of the polymer preparation, to tumor-bearing mice resulted in the accumulation of P<sup>32</sup> in solid tumors equal to or exceeding that of the highest normal tissue (liver). Subfractionation of the toluene insoluble non-dialyzable portion of PXP<sup>32</sup> gave fractions with different tumor/liver P<sup>32</sup> ratios, the highest ratio resulting from the administration of the PXP<sup>32</sup> fraction which was soluble in isobutanol at pH 1.20 but did not migrate in counter-current distribution at pH 2.85.

Isolation of radioactive ribonucleic acids from the livers and tumors of mice administered PXP<sup>32</sup> demonstrated the partial metabolism of the polymer to inorganic phosphate *in vivo*. Differences in the ratio of P<sup>32</sup>/H<sup>3</sup> in mice receiving the doubly-labeled PXP<sup>32</sup>-H<sup>3</sup> indicated that different tissues vary in their ability to hydrolyze the polymer *in situ*, retain the inorganic phosphate and liberate a tritium-containing metabolite into the bloodstream.

It is shown that the excretion of P<sup>32</sup> in the feces of mice receiving PXP<sup>32</sup> is by way of the biliary system and that the dialysis rate of the fecal P<sup>32</sup> resembles the dialysis rate of the polymer; urinary P<sup>32</sup> dialysis rate resembled that of Pi<sup>32</sup>.

Repeated administration of PXP to mice did not result in any significant gross or microscopically-observable abnormalities which could be attributed to the polymer. Repeated administration of PXP<sup>32</sup> to tumor-bearing mice resulted in lower P<sup>32</sup> concentration in all tissue except the tumor, as compared to the effect of repeated administration of Pi<sup>32</sup>. The percent of administered P<sup>32</sup> in the mouse tissues, including tumor, was lower following repeated doses than after a single dose of PXP<sup>32</sup> indicating that the tissues became saturated with the polymer and the excess was excreted.

Although rapidly growing young tumors were observed to concentrate more P<sup>32</sup> from PXP<sup>32</sup> than did older tumors, regenerating liver contained less P<sup>32</sup> than did normal liver, implying that the P<sup>32</sup> uptake is not directly related to the mitotic index of a tissue.

Treatment of tumor-bearing mice with cortisone and Thorotrast during the administration of PXP<sup>32</sup> depressed the uptake of P<sup>32</sup> by the liver and spleen, but had no effect on tumor uptake. Part of the uptake of the polymer by liver and spleen therefore is due to reticulo-endothelial action.

The rate at which P<sup>32</sup> is cleared from the blood of animals receiving PXP<sup>32</sup> is very rapid for the first 9 hours and then becomes gradually slower. The evidence presented has been interpreted to indicate that the organism reacts as if two materials had been administered, with biological half-lives of 16 and 46 hours, respectively. The major portion of the P<sup>32</sup> in the blood two days after administration of the polymer is bound to albumin, the rest being bound to other plasma proteins. After incubation of mouse blood *in vitro* with PXP<sup>32</sup> a considerable portion of the radioactivity is not bound to protein but remains in the protein-free filtrate.

The possible roles of capillary permeability, cellular histones and cellular phosphatases are discussed in relation to the uptake of P<sup>32</sup> by tumor tissue.

Microfilm \$2.50; Xerox \$7.80. 166 pages.

THE ACTION OF DESOXYCORTICOSTERONE  
ACETATE (DOCA) ON GLYCOGEN FORMATION  
IN RELATION TO ITS ACTION ON  
POTASSIUM METABOLISM IN LIVER  
AND GASTROCNEMIUS MUSCLE OF  
THE ALBINO RAT

(L. C. Card No. Mic 60-4704)

William Niedermeier, Ph.D.  
University of Alabama, 1960

In these studies an attempt was made to explain the mechanism whereby DOCA caused a decrease in glycogen production in liver and gastrocnemius muscle in response to intraperitoneally injected glucose.

An increase in potassium content of tissues normally accompanied increases in glycogen content. Therefore, the possibility that the DOCA inhibition of glycogen formation was secondary to its effect in lowering tissue potassium levels was investigated.

Rats which were allowed tap water *ad libitum* were injected subcutaneously with doses of 0.5 to 5.0 mg. of DOCA daily for periods of 1 to 14 days. Then after fasting for 24 hours, 200 mg. of glucose per 100 grams of body weight were injected intraperitoneally. Four hours later, the liver, gastrocnemius muscle and blood serum were analyzed for potassium and glycogen. In these rats there was a positive correlation between the potassium level of the tissue and the amount of glycogen produced from the injected glucose.

The experiment was repeated with rats which were given 1.0% potassium chloride solution to drink instead of tap water. In these rats, potassium levels of the above tissues were significantly higher and glycogen formation in response to injected glucose more nearly approached that of the control rats that were not treated with DOCA.

The above experiments were repeated with bilaterally adrenalectomized rats, but no positive correlation was found between potassium level of the tissues and the amount of glycogen produced from injected glucose. To the contrary, the tissues from adrenalectomized rats that received 5.0 mg. of DOCA daily for 14 days had the lowest potassium values of any tissues analyzed, but produced more glycogen than tissues from adrenalectomized rats which received smaller doses of DOCA and had more nearly normal potassium levels. Increasing the potassium intake of adrenalectomized rats that received daily injections of DOCA had no apparent influence on glycogen production in either the liver or the gastrocnemius muscle.

It was concluded that the parallelism between potassium level of the tissues and their capacity to produce glycogen in intact rats was coincidental. The inhibition which DOCA exerted on glycogen production was apparently not due to a primary tissue potassium deficiency.

In further studies it was determined that the amount of glucose absorbed from the peritoneal cavity in four hours was essentially the same both for intact and



adrenalectomized rats, under all conditions employed in these studies, and that DOCA was without apparent influence.

The action of 17-hydroxycorticosterone when injected alone and when injected in combination with 5.0 mg. of DOCA, was studied in adrenalectomized rats at daily dose levels of 0.625 to 2.5 mg. for 14 days. The effect of the combined action of these two steroids on liver glycogen formation was the sum of the effect of each when injected singly. The possibility of direct antagonism or synergism between these two compounds was thus apparently ruled out as a factor in effecting glycogen formation.

Decreases in the activity of glandular structures are in general, reflected by atrophy of the gland as measured by losses in the weights of the glands. It was found that the injection of DOCA resulted in a decrease in the weight of the adrenal glands. By increasing the potassium intake of the rats, the effect of DOCA on adrenal atrophy was reversed. These observations when considered in the light of the results reported by other investigators indicate that the action of DOCA on the inhibition of glycogen formation in intact rats was probably the result of lowered glucocorticoid release resulting from atrophy of the adrenal glands.

Microfilm \$2.50; Xerox \$8.00. 174 pages.

#### STUDIES ON THE BIOCHEMICAL MECHANISMS OF ACTIVE TRANSPORT

(L. C. Card No. Mic 60-5167)

Clarence Scott Potter, Ph.D.  
University of Minnesota, 1960

This thesis is concerned with the mechanisms of transport of non-electrolytes, especially sugars, across cell membranes. Glucose-1- $O^{18}$  was used in the first section to study the fate of the oxygen at carbon one of glucose when transported against a concentration gradient by an intestinal loop *in vitro*. It was shown that glucose, heated with  $H_2O^{18}$  at  $100^\circ$ , equilibrated only one oxygen with that of  $H_2O^{18}$ . The product was thus glucose-1- $O^{18}$ . A method was developed allowing determination of  $O^{18}$  content of 2 mg. of glucose-1- $O^{18}$  in solution. Glucose isolated after transport by the intestinal loop contained 40% less  $O^{18}$  than the original glucose. Spontaneous, buffer catalyzed exchange between glucose and water oxygens was estimated to have caused about 1/3 of this  $O^{18}$  loss. Part or all the remaining decrease in  $O^{18}$  content was likely due to unlabeled, endogenous glucose dilution of labeled glucose. The results show that no obligatory step in glucose transport causes the removal of one atom of oxygen from carbon-one per glucose molecule transported. The results make very unlikely certain mechanisms of transport, as intermediate glycoside formation.

In the second section, differential centrifugation was used to study the distribution of adenosine triphosphatase (ATPase) activity of an actively transporting tissue, the intestinal mucosa. An 'easily sedimentable' fraction was obtained from mucosal homogenate at  $200 \times g$  which was expected to contain cell membranes. The ATPase specific activity of this fraction was about equal to that of the whole

homogenate, while the total activity was only 5% of the homogenate's. 1/3 of this 5% was found to be due to mitochondrial contamination. Additional ATPase activity may have been contributed through nuclear contamination. The results give no evidence for an ATPase activity associated with active transport or cell membranes.

The Schneider method for the determination of deoxy-ribose nucleic acid (DNA) content of tissues was evaluated. Recoveries of highly polymerized DNA added to intestinal mucosal homogenates were variable and ranged from 70% to 89%. However, recoveries of DNA carried through the procedure in the absence of tissue homogenate were consistently better than 95%. The probable cause of the low and variable recoveries of DNA added to tissue homogenates was the hot perchloric acid extraction step.

The third section was the development of methods of labeling cell membranes, using radioactive compounds which react very rapidly with protein functional groups. If its reaction were rapid enough, a compound should not penetrate the cell without prior reaction with the cell wall or membrane. Erythrocytes were used as a test system; the ratio of radioactivity incorporated into the stroma to that into hemoglobin was used to indicate cell membrane compared to cell interior labeling. Using acetic-1- $C^{14}$  anhydride in dioxane, the hemoglobin contained twelve times the radioactivity of the stroma. This reagent was concluded not to be satisfactory for the purpose at hand. The level of p-nitrodiazobenzene- $C^{14}$ , prepared from aniline- $C^{14}$ , which labeled stroma without causing excess hemolysis was insufficient to allow determination of the hemoglobin-incorporated radioactivity by direct plating. Since labeling of hemoglobin equal to that of the stroma would have been difficult to detect by direct hemoglobin plating, p-nitrodiazobenzene could not be concluded to label the cell membrane or wall exclusively. However, since the expected product of diazo salt-protein reaction was azo compounds, the reductive cleavage of the radioactivity from hemoglobin was attempted and found successful. However, it was not possible to quantitatively isolate the cleaved radioactivity from the reductive cleavage mixture. Neither acetic-1- $C^{14}$  anhydride nor p-nitrodiazobenzene- $C^{14}$  were apparently suitable cell wall or membrane labeling reagents.

Microfilm \$2.50; Xerox \$7.60. 161 pages.

#### PHENYLALANINE METABOLISM AND THYROIDAL ACTIVITY IN RATS FED RAW SOYBEAN OIL MEAL

(L. C. Card No. Mic 60-5578)

Agaram Subba Rao, Ph.D.  
The University of Nebraska, 1960

Adviser: Raymond Borchers

In 1917, Osborne and Mendel observed that rats fed raw soybeans grew more slowly than rats fed cooked soybeans. Extensive studies to find out how raw soybeans reduce the growth rate have not resulted in location of the primary site of action of raw soybeans. These studies have, however, yielded valuable data relating action of raw soybeans to various biochemical functions. The present



results show that two additional systems--phenylalanine metabolism and thyroidal activity--are associated with growth retarding action of raw soybeans. The effects on the thyroid are suggested as a probable primary site of action of raw soybeans.

The present studies have shown that the metabolism of phenylalanine was affected by the feeding of raw soybean oil meal (SBOM). In rats fed a 25% raw SBOM ration, urinary phenylalanine excretion was five times greater than the controls over a 20-day feeding period and liver phenylalanine hydroxylase (PAH) activity was reduced to 50% of the controls on the third day. The PAH activity increased with longer feeding but did not reach that of the controls. Increase in the raw SBOM level to 40% of the ration increased the PAH activity; supplementing with tyrosine reduced the enzyme level.

The apparent Michaelis constant ( $K_m$ ) of the liver PAH enzyme system was approximately  $5 \times 10^{-4}$  molar in preparations from rats fed stock ration, heated SBOM ration for 3 or 11 days, and raw SBOM ration for 11 days. However, the  $K_m$  value for the enzyme from rats fed raw SBOM for 3 days was very large.

Feeding raw soybeans did not affect the level of all enzymes. The activities in liver preparations of the tyrosine oxidase system, xanthine oxidase, and endogenous respiration were similar in rats fed raw or heated SBOM rations.

Thyroidal radioiodide uptake showed a marked reduction in rats fed raw soybeans. Uptake of radioiodide in rats fed a 25% raw SBOM ration for 3 days was only 10% of the controls at 6 hours after injection increasing to 25% of the controls at 24 hours. After 20 days on the raw SBOM ration, the uptake was 58% of the controls. Thyroidal activity as indicated by the ratio of radioiodide in the thyroid to plasma gave similar results.

Thyroidal activities as measured by radioiodide uptake in rats fed 40% SBOM rations or 25% SBOM rations supplemented with antibiotics were altered from the above. Uptake on the heated SBOM rations decreased while uptake on the raw SBOM rations increased. An amino acid supplement had no effect on thyroidal activity of rats fed raw SBOM but reduced the uptake in those fed heated SBOM.

As well as pointing out additional systems affected by the feeding of raw soybeans, these results suggest possible relationships in the functions of thyroxine, dietary antibiotics, and protein synthesis. Animals fed raw soybeans will be useful for the study of these relationships.

Microfilm \$2.50; Xerox \$4.20. 77 pages.

#### FACTORS AFFECTING ABSORBABILITY OF SATURATED FATTY ACIDS IN THE CHICKEN

(L. C. Card No. Mic 60-6468)

Ruth Olive Ann Renner, Ph.D.  
Cornell University, 1960

Studies have been conducted to determine the absorbability of fatty acids in the chicken and factors affecting this absorbability.

For these determinations, chickens were fed a semi-purified diet containing chromic oxide as an indicator and

in which 20 parts of the carbohydrate were replaced either weight for weight or isocalorically by the fat, fatty acid or mixture of lipids under study. Whenever possible, substitutions were made isocalorically in order to maintain constant energy:protein, energy:vitamin and energy:mineral ratios. Fecal collections were made during the fourth week and utilization of fat or fatty acid was determined by (1) metabolizable energy determined by bomb calorimetry and (2) absorbability. Absorbability of individual fatty acids when fed in mixtures with other fatty acids was made by analysis of dietary and fecal fat for constituent fatty acids using gas chromatography.

Results showed that in the four-week-old chick the absorbability of saturated fatty acids decreased as chain length increased, the values being 65, 25, 2 and -2%, respectively, for lauric, myristic, palmitic and stearic acid. Oleic acid was found to be well utilized by the chick, the absorbability value being 88%.

Similar studies conducted with the adult hen showed the absorbability of myristic, palmitic, stearic and oleic acid to be 30, 11, 4 and 94%, respectively. These results indicate that the hen is better able to utilize these fatty acids than is the chick at four weeks of age. Since the hens refused to eat a diet containing lauric acid no value is available for lauric acid utilization.

Attempts to improve the utilization of palmitic acid by feeding in mixtures with unsaturated fatty acids, triglycerides or monoglycerides were successful but the degree of improvement achieved did not compare to the marked improvement obtained when it was fed in the form of the mixed triglycerides present in lard or tallow. Thus it appears that it is the attachment of the saturated fatty acids to the triglyceride molecule which causes most improvement in utilization and perhaps the extent to which they remain attached determines the absorbability of the fat.

In this regard, results of studies on the absorbability of palmitic acid in natural, partially rearranged and completely rearranged lard have shown that in the chick the absorbability of palmitic acid decreased with increasing degree of rearrangement of the fatty acids in the constituent triglycerides. These results indicate that the absorbability of palmitic acid in lard varies with point of attachment of the acid in the triglyceride molecule, the absorbability of palmitic acid being higher when located in the 2-position than in the 1-position of lard triglycerides.

The absorbability of palmitic acid was also found to be improved when fed as methyl palmitate or monopalmitin, again demonstrating the beneficial effect of the ester linkage. No improvement in absorbability of palmitic acid was noted when fed as tripalmitin or a mixture of sodium and potassium palmitates.

Studies also showed that the absorbability of palmitic acid by the chick was increased by the addition of 0.1% sodium taurocholate or 2% lecithin to a diet containing 20% and 18% palmitic acid, respectively. It was unaffected by the addition of glycerol,  $\alpha$ -glycerophosphate, an anionic detergent, sodium alkyl sulfate, or a cationic detergent, Hyamine 1622.

Evidence has accumulated during the course of these experiments which supports the "Particulate Theory" of fat absorption in the chick.

Microfilm \$2.50; Xerox \$4.20. 78 pages.



# THE MECHANISM OF ENZYMATIC PHOSPHATE TRANSFER REACTIONS

(L. C. Card No. Mic 60-5168)

Alan Mark Reynard, Ph.D.  
University of Minnesota, 1960

The principal objective of this thesis was to determine, through kinetic and substrate binding studies with muscle pyruvate kinase, if common binding sites on the enzyme were shared by ADP and ATP and by phosphopyruvate and pyruvate, and if compulsory orders of binding existed.

The apparent Michaelis constant for ADP at 0° and pH 8.5 increases slightly with increase in phosphopyruvate concentration, whereas the apparent Michaelis constant for phosphopyruvate is not appreciably changed by change in the ADP concentration. These findings show that the system does not closely follow an either random or compulsory order of substrate binding with "equilibrium kinetics" applying.

ATP had a pronounced inhibitory effect on the initial rate of formation of ATP from ADP and phosphopyruvate, AMP was without inhibitory effect, and pyruvate inhibited weakly. The inhibition by ATP was readily overcome by increase in the phosphopyruvate concentration, but only slightly decreased by increase in the ADP concentration. These results show a probable binding competition between ATP and phosphopyruvate.

Binding measurements by ultracentrifugal techniques showed binding of approximately 1 mole of phosphopyruvate per 100,000 grams of enzyme preparation with a  $K_D$  of  $7.5 \times 10^{-5}$ . ATP strongly inhibited the binding. Pyruvate was weakly bound as measured by equilibrium dialysis. Binding of ADP and ATP was difficult to quantitate because of presence of traces of adenylate kinase in the preparations. The data do clearly show that presence of ATP interfered with ADP binding.

Evaluation of the kinetic and binding data points strongly to a pyruvate kinase mechanism in which there is a common binding site for ATP and ADP, and another site for pyruvate and phosphopyruvate, with competition between ATP and phosphopyruvate for binding because phosphoryl groups of ATP and phosphopyruvate bind to the same locus. Substrates appear to combine independently, but not in close accord with kinetics expected for phosphate transfer being the rate limiting step. The inability of ADP to readily overcome the ATP inhibition for pyruvate kinase, and for the analogous situation reported by Bücher for 3-phosphoglycerate kinase does not necessitate postulation of separate binding sites for ADP and ATP. Theoretical equations developed incorporating the above assumptions are in reasonable agreement with the findings in this thesis and those of Bücher with 3-phosphoglycerate kinase (Biochim. Biophys. Acta, 1, 292, 1947).

When pyruvate kinase was incubated under conditions used for the catalytic reaction with  $\beta, \gamma$ -ATP<sup>32</sup> no significant amount of radioactivity was found in the protein after precipitation with ammonium sulfate or trichloroacetic acid. This argues strongly against the possibility that the pyruvate kinase reaction proceeded by means of an enzyme-phosphate intermediate.

The pyruvate kinase used in the studies was prepared from rabbit muscle essentially as described by Tietz and Ochoa (Arch. Biochem. Biophys. 78, 477, 1959). Electrophoretic studies indicate possible heterogeneity of the

preparation. Attempts at further purification by ion-exchange techniques were unsuccessful. For the measurement of phosphopyruvate, a useful procedure of borohydride reduction of free pyruvate was developed. This allowed measurement of pyruvate subsequently liberated by hydrolysis of phosphopyruvate.

Microfilm \$2.50; Xerox \$6.40. 135 pages.

# POLYMERIZATION OF 1-ACRYLAMIDO-1-DEOXY-D-GLUCITOL AND ITS REACTION WITH AMYLOSE

(L. C. Card No. Mic 60-4206)

Hugh Jack Roberts, Ph.D.  
Purdue University, 1960

Major Professor: Roy L. Whistler

In an improved synthesis of 1-acrylamido-1-deoxy-D-glucitol (N-acryloyl-D-glucamine), acryloyl chloride is reacted in aqueous potassium carbonate solution with 1-amino-1-deoxy-D-glucitol (D-glucamine) either as the free base or as the oxalic acid salt.

Dilute solutions of N-acryloyl-D-glucamine and the corresponding methacryl compound, are polymerized by redox initiator systems, persulfates, benzoyl peroxide and  $\alpha, \alpha'$ -azoisobutyronitrile. Highest viscosity numbers are obtained with the use of persulfate-bisulfite at low temperature. Concentrated aqueous solutions of N-acryloyl-D-glucamine at low temperature with ammonium persulfate-sodium bisulfite yield neutral hydrophilic polymers having viscosities comparable with those of the natural and synthetic gums. These polymers are, however, water-dispersible rather than water-soluble. Polymerization of aqueous solutions of N-acryloyl-D-glucamine by potassium persulfate at 80° produces soluble, ionic polymers as a result of hydrolysis of some of the amide bonds. Neutral, soluble polymers of moderately high viscosity are obtained upon polymerization in the presence of the non-polymerizable homolog, 1-acetamido-1-deoxy-D-glucitol (N-acetyl-D-glucamine).

These polymers show a high degree of tolerance for electrolytes. Borate ion causes the gelation of concentrated solutions of poly (N-acryloyl-D-glucamine).

Amylose reacts with N-acryloyl-D-glucamine in aqueous base. Temperatures above 70°, base concentrations above 0.3 molar, and reaction times much in excess of 12 hours bring about hydrolysis of some of the amide bonds resulting in the introduction of carboxyl groups. The use of a 10 molar solution of lithium chloride in place of water as the solvent for the reactants provides a completely homogeneous reaction mixture in which the hydrolysis of amide bonds is lessened. The product of the reaction between amylose and N-acryloyl-D-glucamine is given the trivial name "glucamidoethyl amylose."

Fractionation of "glucamidoethyl amylose" on the basis of its solubility in water-ethanol mixtures gives rise to fractions having different nitrogen contents. As the percentage of ethanol in such mixtures is increased, fractions containing an increasing amount of nitrogen are obtained. Fractions having degrees of molar substitution (M.S.) ranging from 0.20 to 0.82 are described.



The fractions are soluble in water, with the solubility increasing with increasing amounts of substitution. The solutions give a blue color with iodine, but bind no iodine as measured by potentiometric titration. The optical rotation is decreased by increasing amounts of substitution. These derivatives of amylose do not retrograde nor do they complex with butanol.

"Glucamidoethyl amylose" fractions are hydrolyzed by boiling dilute sulfuric acid and by  $\alpha$ -amylase to the same extent as amylose, but their susceptibility to  $\beta$ -amylase action is much less. The limiting viscosity number of a fraction of "glucamidoethyl amylose" of M.S. 0.29 in water is the same as that of amylose in molar potassium hydroxide solution; an increase in M.S. to 0.40 decreases the limiting viscosity number to one-third of that value. Alkaline hydrolysis of a "glucamidoethyl amylose" fraction (M.S. = 0.29) yielded a nitrogen-free product containing no detectable carboxyl groups. These results are discussed in terms of the possible structure of "glucamidoethyl amylose."

Microfilm \$2.50; Xerox \$4.00. 75 pages.

#### HALOGENS, TAUROBETAINE AND WAXES IN GORGONIANS.

(L. C. Card No. Mic 60-5192)

Robert Wayne Schmidt, Ph.D.  
The University of Oklahoma, 1960

Major Professor: Leon S. Ciereszko

Gorgonian skeletons contain relatively large amounts of halogens and the cortex contains high concentrations of lipids. The purpose of this study was to determine the halogen (Schöniger's (1, 2) method) and nitrogen contents of the skeletons and to investigate the cortex by successively extracting with n-pentane, diethyl ether, acetone and methanol.

The content (%) iodine, bromine and nitrogen found in sixteen species of gorgonians is as follows. *Briareum asbestinum* (Rabbit Cay<sup>a</sup>), 0.00, 0.07, 1.79; *Eunicea grandis* (Castle Harbor<sup>b</sup>), 1.29, 2.83, 12.15; *Eunicea grandis* (Ferry Point<sup>b</sup>), 1.21, 3.18, 11.94; *Eunicea grandis* (Somerset<sup>b</sup>), 1.71, 2.99, 13.06; *Eunicea mammosa* (Rabbit Cay), 2.29, 3.22, 13.55; *Eunicea mammosa* (Rabbit Cay), 2.09, 2.57, 12.55; *Eunicea mammosa* (Rabbit Cay), 1.98, 2.79; *Eunicea tourneforti* (Castle Harbor), 0.89, 3.44, 12.18; *Eunicea tourneforti* (Somerset), 1.41, 2.99, 13.27; *Eunicea tourneforti* (Ferry Point, gangling form), 1.41, 3.47, 10.07; *Muricea muricata* (Castle Harbor), 1.70, 1.02, 13.51; *Plexaura crassa* (Castle Harbor), 1.49, 2.44, 11.92; *Plexaura crassa* (North Rock<sup>b</sup>), 2.16, 2.44, 12.78; *Plexaura esperi*<sup>b</sup>, 1.36, 2.58, 12.80; *Plexaura flavida* (Rabbit Cay), 2.60, 0.63, 14.17; *Plexaura flexuosa* (Ferry Point, brown), 1.64, 3.26, 12.05; *Plexaura flexuosa* (Ferry Point, purple), 2.09, 2.73, 12.05; *Plexaura homomalla* (Castle Harbor), 1.32, 2.95, 11.62; *Plexaura homomalla* (Somerset), 1.52, 2.61, 10.92; *Plexaurella dichotoma* (?) (Castle Harbor), 0.00, 0.37, 4.35; *Plexaurella dichotoma* (?) (Somerset), 0.00, 0.28, 2.93; *Plexaurella nutans* (?) (North Rock), 0.11, 0.22, 2.91; *Pterogorgia acerosa* (Castle Harbor, cortex left on), 0.31, 0.32, 5.88;

*Pterogorgia acerosa* (N. of N. Bimini, cortex left on), 0.27, 0.16, 5.82; *Pterogorgia acerosa* (N. of N. Bimini), 0.80, 0.56, 12.58; *Pterogorgia americana* (North Rock, cortex left on), 0.36, 0.50, 5.20; *Rhipidogorgia flabellum* (Somerset, cortex left on), 0.32, 0.33, 6.87; *Rhipidogorgia flabellum* (Rabbit Cay, cortex left on), 0.39, 0.39, 5.76; *Rhipidogorgia flabellum* (Rabbit Cay), 0.79, 1.01, 13.11; *Xiphigorgia citrina* (N. Turtle Rock<sup>a</sup>), 0.82, 0.64, 11.92.

No significant relationships were found between halogen content and geographical location or color for organisms of the same species. The I/N and Br/N mole ratios were found to be significantly higher in the *Plexauridae* than the *Gorgoniidae*.

Taurobetaine was isolated from the methanol extract of *Briareum asbestinum* independently of Ackermann and List (3) who obtained it from sponges. The taurobetaine was identified by comparison with synthetic taurobetaine and by identifying the products of alkaline degradation. The alkaline degradation of taurobetaine yields trimethylamine and ethylene sulfonic acid rather than isethionic acid as previously reported.

The wax from the n-pentane extract of *Plexaurella nutans* and of *Briareum asbestinum* was identified as cetyl palmitate by comparison with authentic cetyl palmitate. The waxes from the n-pentane extracts of *Plexaura crassa* and *eunicea grandis* were shown to be different from cetyl palmitate, and are probably higher homologs.

1. Schöniger, W., *Mikrochim. Acta*, (1955), 123.
2. Schöniger, W., *ibid.*, (1956), 869.
3. Ackermann, D., and List, P. H., *Naturwissenschaften*, 46, 354 (1959).
- a. Bimini, B. W. I.
- b. Bermuda.

Microfilm \$2.50; Xerox \$3.00. 54 pages.

#### BIOSYNTHESIS OF CELL WALL L-RHAMNOSE IN GROUP A STREPTOCOCCI

(L. C. Card No. Mic 60-5316)

Wendell Homer Southard, Ph.D.  
University of Illinois,  
Chicago Professional Colleges, 1960

Group A streptococci were grown in a medium to which either 1-C<sup>14</sup>-glucose or 6-C<sup>14</sup>-glucose was added. The cell walls were hydrolyzed, and the rhamnose was crystallized after passage of the hydrolysate through a cationic and anionic exchange resin. Carbon 1, carbons 2+3+4, and carbons 5+6 of the rhamnose were ultimately obtained as barium carbonate, and the distribution of the radioactivity was determined. The results indicated that glucose is converted to L-rhamnose without appreciable dilution of the radioactivity. In neither experiment was evidence for randomization of the glucose label between carbons 1 and 6 of rhamnose obtained, and therefore a direct conversion of D-glucose to L-rhamnose is suggested.

The examination of other cell wall components from the 1-C<sup>14</sup>-glucose experiment showed glucosamine and muramic acid to be highly radioactive and to possess

approximately equal specific activities. These findings are in agreement with the known pathways of glucosamine and muramic acid biosynthesis. Alanine was only slightly radioactive probably due to dilution with unlabeled alanine of the medium.

Growth studies of a type 14 streptococcus, containing a cell wall glucosamine to rhamnose ratio of approximately 1:1, demonstrated that 0.005 units of penicillin per ml. was capable of completely inhibiting the growth of the organism within 1-2 hr. after the addition of the antibiotic during the logarithmic growth phase. Similar investigations of a variant group A organism, with a cell wall glucosamine to rhamnose ratio of 1:5, indicated that a concentration of 1 unit per ml. was required for inhibition of growth. The decrease in sensitivity of the organism to penicillin with a concomitant relative decrease in cell wall content of glucosamine is compatible with the mechanism of penicillin action which has been proposed by earlier investigators.

Fifty per cent ethanol extracts of both normal and penicillin-inhibited variant group A streptococci were fractionated with barium and ethanol. Column chromatography of the barium-soluble, alcohol-insoluble fraction on anion exchange resins failed to demonstrate the presence of significant amounts of rhamnose derivatives. Examination of the barium-insoluble fraction by chromatography on a Dowex 1(chloride) column, however, demonstrated the presence of two peaks containing rhamnose. The amount of rhamnose was increased approximately ten fold in each of the peaks from the extracts of the penicillin-inhibited cells. Partial characterization of the first peak, which comprised approximately ninety per cent of the rhamnose in the fraction was undertaken. The data suggested that the material is a mixture of rhamnose oligosaccharides of more than three monosaccharide units containing phosphorous in a ratio of 1 mole phosphorous to 4.4 moles rhamnose. It is suggested that the oligosaccharides are fragments of an incomplete basal cell wall structure which accumulated due to the inability of the organism to incorporate a muramic acid-peptide component in the presence of penicillin. The second rhamnose derivative has been tentatively identified as a monosaccharide, with a molar ratio of rhamnose to phosphate of 1:3. The high phosphorous content of the compound may indicate the presence of other unidentified phosphate-containing compounds as impurities.

Microfilm \$2.50; Xerox \$5.20. 103 pages.

#### PREPARATION AND PROPERTIES OF POLYSACCHARIDE SULFATES

(L. C. Card No. Mic 60-4216)

Walter William Spencer, Ph.D.  
Purdue University, 1960

Major Professor: Roy L. Whistler

Polysaccharides are sulfated with triethylamine-sulfur-trioxide complex in dimethylformamide solvent at 0°C. Polysaccharides, such as amylose, amylopectin and guaran, which have an abundance of primary hydroxyls are easily esterified under these conditions. Dextran, alginic acid and gum arabic, which have only a relatively

few or no primary hydroxyls are esterified not at all or only to a low level.

Guaran and amylopectin sulfates are highly water-soluble and below a degree of substitution of one show an increased viscosity in water with increased sulfur content. Amylose sulfates below a degree of substitution of one are partially water-insoluble, but above a degree of substitution of one are water-soluble and form relatively viscous solutions.

Unlike carrageenan, these polysaccharide sulfates do not form a gel with calcium, potassium or ammonium ions. All of the sulfated polysaccharides, with the exception of those with a very low sulfur content gave a precipitate with methylene blue, egg albumin and gelatin solutions.

Limiting viscosity numbers of the sulfated polysaccharides in 0.1N sodium chloride solution indicate little or no degradation below a degree of substitution of one. Osmotic pressure data of amylose sulfate of degree of substitution of 2.01 indicates a molecular weight of 372,000 (degree of polymerization of 1020).

Periodate consumption of amylopectin, amylose and guaran sulfates of a degree of substitution of one indicate that 50 to 60% of the sulfate groups are on C<sub>6</sub> primary hydroxyls.

Sulfate groups in amylopectin sulfate of degree of substitution of one are hydrolyzed by both aqueous 5N sodium hydroxide at 100°C. and 2.5N potassium hydroxide in 50% ethanol at 80°C. The material hydrolyzed with aqueous base is noticeably degraded. The material isolated from the alcoholic alkaline hydrolysis forms swollen transparent particles in water. Paper chromatography of the acid hydrolysate of partially desulfated amylopectin sulfate shows only two spots. The major spot is D-glucose and the minor spot has an R<sub>f</sub> value corresponding to authentic 3,6-anhydro-D-glucose.

A film cast from amylose sulfate of degree of substitution of one is translucent, deliquescent and weaker than a film cast from underivatized amylose. Films of underivatized guaran and guaran sulfate, degree of substitution of 1.0, are quite comparable to each other in regard to tensile strength and percent elongation. The guaran sulfate film has a tensile strength four times greater than the amylose sulfate film.

Microfilm \$2.50; Xerox \$4.20. 77 pages.

#### THE BIOGENESIS OF THE ERGOT ALKALOIDS

(L. C. Card No. Mic 60-6134)

Elmore Hector Taylor, Ph.D.  
Purdue University, 1960

Major Professor: Egil Ramstad

To test the hypothesis that mevalonic acid is the precursor of the isoprenoid fragment of lysergic acid and of the clavine-type ergot alkaloids, mevalonic acid-2-C<sup>14</sup> was fed to alkaloid producing strains of Claviceps purpurea in saprophytic cultures.

The alkaloidal fraction obtained from saprophytic cultures of Strain PRL 1578 of Claviceps purpurea contained several labelled alkaloids of the peptide type.



Hydrolysis of the alkaloids followed by chromatography and autoradiography showed that all of the radioactivity resides in the lysergic acid moiety of the alkaloids and none in the peptidic side chain. Radiochemically pure lysergic acid was decarboxylated and the carbon dioxide found to be radioactive.

The alkaloidal fraction derived from saprophytic cultures of Strain 47A of *Claviceps purpurea* yielded several radioactive alkaloids of the clavine type. The specific activities of agroclavine and elymoclavine were identical indicating a common biogenetic pathway. Radioactive agroclavine and elymoclavine were reduced and a Kuhn-Roth oxidation of the product yielded labelled acetate from C-17 and C-8 of the alkaloids.

The results of the work may be summarized as follows:

1. The feeding of mevalonic acid-2-C<sup>14</sup> to saprophytic cultures of *Claviceps purpurea* (Fries) Tulasne (PRL 1578) led to the formation of labelled peptide-type ergot alkaloids, viz. ergometrine, ergometrinine, ergotamine, ergosine, ergosinine, ergocryptine and ergocryptinine.
2. The specific activities of the alkaloids when isolated from the same culture were approximately the same, a fact indicating a common biogenetic pathway.
3. Alkaline hydrolysis of the labelled peptide-type alkaloids yielded radioactive lysergic acid, while the amino acids were non-radioactive.
4. Degradation of labelled lysergic acid obtained from radiochemically pure ergometrine, ergotamine and ergosine showed that the carboxyl group (C-17) of lysergic acid was radioactive. Mevalonic acid serves as a precursor of the isoprenoid fragment of lysergic acid, carbon 2 of mevalonic acid becoming the carboxyl carbon of lysergic acid.
5. The feeding of mevalonic acid-2-C<sup>14</sup> to saprophytic cultures of *Claviceps purpurea* (PRL 1578) led to the formation of three radioactive water-soluble red pigments in the mycelium.
6. The feeding of mevalonic acid-2-C<sup>14</sup> to saprophytic cultures of Strain 47A of *Claviceps purpurea* led to the formation of radioactive clavine-type ergot alkaloids, viz. penniclavine, elymoclavine, setoclavine, and agroclavine.
7. The specific activities of agroclavine and elymoclavine isolated from Strain 47A were identical, a fact indicating common biogenetic pathway.
8. The specific activities of the clavine-type ergot alkaloids isolated from the mycelium were lower than those of the alkaloids from the nutrient medium. This fact may indicate that the alkaloids are formed at the cell surface.
9. A Kuhn-Roth oxidation of reduced agroclavine and elymoclavine yielded labelled acetic acid, a fact indicating the presence of the radioactivity in C-17 of the clavine-type ergot alkaloids.
10. The findings provide evidence that mevalonic acid reacts with tryptophan to form lysergic acid and the clavine-type ergot alkaloids.

Microfilm \$2.50; Xerox \$7.00. 147 pages.

STUDIES ON TWO PROTEINS INVOLVED IN  
BLOOD COAGULATION.  
PART I. CHEMICAL AND PHYSICAL STUDIES  
ON A PARTIALLY PURIFIED BOVINE  
ANTIHEMOPHILIC FACTOR (AHF) PREPARATION.  
PART II. A STUDY OF THE PROTEOLYTIC  
ACTIVITY OF THROMBIN PREPARATIONS.

(L. C. Card No. Mic 60-4873)

Gordon Murray Thelin, Ph.D.  
The University of North Carolina, 1960

Supervisor: Robert H. Wagner, Ph.D.

Through the use of various tools including batch adsorption, salting in, salting out, along with controlled variations in temperature and pH, and selective denaturation, a highly purified AHF fraction was obtained for further studies. The best product obtained was approximately 600 X purified as compared with the starting bovine plasma. The material is fairly stable when stored at -20°C. under desiccant, losing only 43% of its activity after 17 months.

When AHF was sedimented in normal saline solution with an ionic strength of 0.154 it was found that AHF activity sedimented with two boundaries. The boundaries were determined by biological assay of fractional cuts from the sedimentation tube. One peak sedimented at about the same rate as fibrinogen and the other peak sedimented considerably faster. When the solvent was changed to 0.4 M NaCl, the faster boundary disappeared. To investigate the possibility that the faster peak was a lipoprotein, AHF was sedimented in a high density medium (1.56 M NaCl). No floatation of AHF activity was observed and a single boundary was formed that corresponded to the slower boundary above.

The "purest" AHF obtainable was found to adsorb irreversibly at the starting point when subjected to paper electrophoresis. Somewhat less "pure" fractions could be partially eluted and migrated only slightly beyond the starting point. The AHF activity in crude fractions and in plasma was more readily elutable and migrated to the beta-2 region.

Bovine AHF was heated at 49°C. for periods up to three hours. Aliquots were withdrawn at intervals, cleared by centrifugation and the supernatant assayed for AHF, fibrinogen and total protein. There was an initial rapid loss of about half the AHF activity in the first 30 minutes. All of the fibrinogen was precipitated in the same period. Further heating for 2½ hours resulted in only 5-10% loss of the remaining AHF activity. The initial loss of 50% of the AHF activity could be decreased by increasing the ionic strength of the solvent in which the AHF was heated. Decreasing the fibrinogen content of AHF preparation before heating also resulted in a decrease of the initial AHF loss.

Three different preparations of thrombin, of which two were highly purified, were found to digest heated or non-heated bovine serum albumin. The digestion of albumin was investigated by three separate methods: (1) The liberation of amino groups was followed electrotitrimetrically by maintaining the pH of the reaction mixture at 8.8 with additions of standard NaOH. (2) the TCA-soluble N of a thrombin-albumin mixture was analyzed before and



after incubation. (3) The digestion products were also studied with paper electrophoresis. For comparison of thrombin with other proteolytic enzymes, albumin was digested with trypsin. Pre-treatment of albumin, by heating, greatly increases its susceptibility to hydrolysis both by thrombin or trypsin. On any basis of comparison used, trypsin digests albumin or heated albumin more quickly and more thoroughly than thrombin.

Microfilm \$2.50; Xerox \$7.80. 168 pages.

A STUDY OF THE ENZYMATIC AND  
NUTRITIONAL ASPECTS OF GROWTH  
OF *TETRAHYMENA PYRIFORMIS* Y

(L. C. Card No. Mic 60-4707)

Wynelle Doggett Thompson, Ph.D.  
University of Alabama, 1960

A technique has been described for the growth and periodic sampling of axenic mass cultures of *T. pyriformis* Y on a synthetic medium for long periods of time without the entrance of air-borne contaminants. The composite growth curve for eight mass cultures was determined.

Assays for activities of four different enzymes and for total protein have been made, using homogenates of cells of *Tetrahymena pyriformis* Y from six different cultures of this protozoan at two different stages of growth; i.e. the logarithmic or rapidly-dividing stage and the early mature or stationary phase of growth.

Comparisons of the activities of the four enzymes were made to determine if differences in the enzymatic activities of cells from mass cultures at the two stages of growth were statistically significant. Activities of the enzymes were expressed on the basis of total nitrogen content, and also on a cellular basis (the unit number of  $10^7$  cells arbitrarily used for convenience).

The ratio of total protein to nitrogen is the same in cells from early mature cultures and in logarithmic phase cultures. Therefore, total nitrogen content is as valid a basis for comparison of enzymatic activities as is protein nitrogen content, at least for this organism.

The width of cells from mass cultures in the early mature phase is considerably greater than the width of cells from the mass cultures in the logarithmic phase. The length of cells in the later stage is approximately the same as the length of cells in the rapidly dividing stage. These differences in cellular dimensions result in significant differences in cellular volumes. Hence, comparison of enzymatic activities expressed on a cellular basis does not agree with results found by comparison of these same enzymatic activities expressed on the basis of total nitrogen content.

Assays for both total protein and DPNH oxidase activity per mg. total nitrogen of cells of mass cultures at the two stages of growth show no statistically significant change as age of the cultures increases.

Comparisons of the specific activities of both cytochrome *c* reductase and diaphorase on the basis of total nitrogen content of the cells indicated a statistically significant decrease in activity of these enzymes in the

cells of the early mature phase as compared to those of the logarithmic phase.

The specific activities of transaminase on a total nitrogen basis in cells of mass cultures in the early mature phase of growth were significantly greater than the activities in cells of these same mass cultures in the logarithmic phase.

These differences in the chemical composition of cells of mass cultures of *Tetrahymena* at the two stages of growth indicate a difference in the physiological state of the cells.

Nutritional studies were made using the exhausted medium obtained after mass cultures had passed the logarithmic phase of growth.

Cultures of the spent medium inoculated with either stock cultures or with cells from the parent culture showed no growth, but a marked decrease in cell populations occurred.

Cultures of freshly prepared synthetic medium inoculated with cells from a parent mass culture continued to undergo rapid multiplication showing no lag, but a continuance of logarithmic growth.

Various components, or mixtures of various components, of the synthetic medium were added to subcultures, using the spent medium in attempts to identify the exhausted nutrient. The results supported the concept of limitation of growth by exhaustion of a nutrient or nutrients. The results indicated that possibly a combination of several different types of nutrients were involved in this limitation since the entire formula was required to attain the maximum cell populations producible in freshly prepared synthetic medium.

Microfilm \$2.50; Xerox \$5.20. 103 pages.

THE D-HOMOANNULATION OF  
THE BISNORCHOLANE DERIVATIVES

(L. C. Card No. Mic 60-4730)

Milan Radoje Uskokovic, Ph.D.  
Clark University, 1960

Supervisor: Ralph I. Dorfman

It has been established that formation of electron-deficiency at carbon C<sub>(20)</sub> of bisnorcholanes is followed by D-ring enlargement. The different forms of this rearrangement were studied.

The pinacolic rearrangement of 17 $\alpha$ ,20-dihydroxy-bisnorcholanes resulted in 17-keto-17 $\alpha$ ,17 $\alpha$ -dimethyl-D-homoandrostanes. The 17 $\alpha$ ,20-dihydroxy-bisnorcholanes were products of Grignard reaction on the corresponding 17 $\alpha$ -hydroxy-20-keto-pregnane derivative. Thus, bisnorchol-5-ene-3 $\beta$ ,17 $\alpha$ ,20-triol was obtained from 3 $\beta$ ,17 $\alpha$ -dihydroxypregn-5-en-20-one 3 $\beta$ -acetate, bisnorallocholane-3 $\beta$ ,17 $\alpha$ ,20-triol from 3 $\beta$ ,17 $\alpha$ -dihydroxyallopregnan-20-one 3 $\beta$ -acetate, and 17 $\alpha$ ,20-dihydroxybisnorchol-4-en-3-one from 17 $\alpha$ -hydroxyprogesteron 3-ethyl-enoether. The rearrangement was affected either by refluxing the steroid in acetic acid solution containing alternatively catalytic amount of iodine or p-toluenesulfonic acid, or with 98% formic acid at 100°. Thus, the rearrangement of the above



17 $\alpha$ ,20-glycols or their 3 $\beta$ -monoacetates gave: 3 $\beta$ -hydroxy-17 $\alpha$ ,17 $\alpha$ -dimethyl-D-homoandrost-5-en-17-one and its 3 $\beta$ -acetate, 3 $\beta$ -hydroxy-17 $\alpha$ ,17 $\alpha$ -dimethyl-D-homoandrost-17-one and its 3 $\beta$ -acetate, and 17 $\alpha$ ,17 $\alpha$ -dimethyl-D-homoandrost-4-ene-3,17-dione.

The Wagner-Meerwein rearrangement of 20-hydroxy-bisnorallocholanes resulted in 17,17 $\alpha$ -dimethyl-D-homoandrost-17(17 $\alpha$ )-enes. The rearrangement was effected by boiling acetic acid containing alternatively catalytic amounts of iodine or p-toluenesulfonic acid. Thus bisnorallocholane-3 $\beta$ ,20-diol gave 17,17 $\alpha$ -dimethyl-D-homoandrost-17(17 $\alpha$ )-en-3 $\beta$ -ol, 3 $\beta$ -acetoxy-bisnorallocholane-20-ol gave 17,17 $\alpha$ -dimethyl-D-homoandrost-17(17 $\alpha$ )-en-3 $\beta$ -ol acetate, and 20-hydroxy-bisnorallocholane-3-one gave 17,17 $\alpha$ -dimethyl-D-homoandrost-17(17 $\alpha$ )-en-3-one.

The Wagner-Meerwein rearrangement of 20-chlorobisnorallocholane-3 $\beta$ -ol acetate yielded 17,17 $\alpha$ -dimethyl-D-homoandrost-17(17 $\alpha$ )-en-3 $\beta$ -ol acetate. The 20-chloro-derivative was obtained by displacement of the 20-hydroxy group in 3 $\beta$ -acetoxy-bisnorallocholane-20-ol, brought about by gaseous hydrochloric acid in benzene solution. The rearrangement was obtained when the chloro-derivative was adsorbed on a silica gel column.

The Wagner-Meerwein rearrangement of bisnorallochol-20-en-3 $\beta$ -ol acetate, produced by refluxing its acetic acid solution containing a catalytic amount of p-toluenesulfonic acid, yielded 17,17 $\alpha$ -dimethyl-D-homoandrost-17(17 $\alpha$ )-en-3 $\beta$ -ol acetate.

The pinacolic rearrangement of 17 $\beta$ ,17 $\alpha$ -dimethyl-D-homoandrostane-17 $\alpha$ ,17 $\alpha$ -diols achieved by refluxing their acetic acid solutions containing a catalytic amount of iodine, yielded 17,17-dimethyl-D-homoandrostane-17 $\alpha$ -ones. Thus, the 17 $\beta$ ,17 $\alpha$ -dimethyl-D-homoandrostane-3 $\beta$ ,17 $\alpha$ ,17 $\alpha$ -triol 3 $\beta$ -acetate gave 3 $\beta$ -acetoxy-17,17-dimethyl-D-homoandrostane-17 $\alpha$ -one and 17 $\alpha$ ,17 $\alpha$ -dihydroxy-17 $\beta$ ,17 $\alpha$ -dimethyl-D-homoandrostane-3-one gave 17,17-dimethyl-D-homoandrostane-3,17 $\alpha$ -dione.

The exclusive formation of 17-keto-17 $\alpha$ ,17 $\alpha$ -dimethyl-D-homo-steroids in the pinacolic rearrangement of 17 $\alpha$ ,20-dihydroxy-bisnorcholanes shows that, when an electron deficiency at C<sub>(20)</sub> in this series is formed, the 13,17-bond migrates. This is in agreement with electronic and conformational requirements in transition state.

Microfilm \$2.50; Xerox \$7.60. 163 pages.

## CHEMISTRY, INORGANIC

### EXCHANGE OF SODIUM BETWEEN SOLID ALUMINOSILICATES AND MOLTEN SALTS

(L. C. Card No. Mic 60-5219)

Thomas Edward Burgess, Ph.D.  
The University of Connecticut, 1960

The primary aim of this work was to study the exchange of ions between a molten salt system and a solid phase whose structure remains unchanged. The system used consisted of a molten salt mixture of 6.82 mole percent sodium chloride and 93.18 mole percent sodium nitrate. The solid phase was either the open network structure

sodalite (Na<sub>8</sub>Al<sub>6</sub>Si<sub>6</sub>O<sub>24</sub>Cl<sub>2</sub>) or noselite (Na<sub>8</sub>Al<sub>6</sub>Si<sub>6</sub>O<sub>24</sub>SO<sub>4</sub>). Exchange of sodium ions measured by the use of sodium-22 took place readily between the molten phase and the solids at temperatures above 320°C and appeared to be controlled by the diffusion of ions in the solid phase. This assumption is supported by the agreement of the exchange data with the theoretical equation for the diffusion in solids derived from Fick's law under the same boundary conditions. Agreement of the energy of activation for diffusion between the natural sodalite and the pyrolytically prepared material is found, and the value obtained is 12.50 kcal/mole. The energy of activation for the pyrolytic noselite was found to be 9.68 kcal/mole, indicating that diffusion in noselite occurs more readily, probably because of its more open structure. The lack of complete agreement of the exchange data for the pyrolytic sodalite with the theory is assumed to be caused by a rapid exchange at the surface of the particles. It is believed that the particles of the prepared material are actually aggregates of small crystallites; hence, the surface area is considerably larger than expected. This assumption is supported by X-ray and exchange data. The diffusion coefficients, D, for sodium ions in sodalite are found from the exchange data and particle size values. These appear in the following table.

Temperature (°C)	(cm <sup>2</sup> D/min)
320	3.26 x 10 <sup>-11</sup>
340	4.94 x 10 <sup>-11</sup>
360	6.67 x 10 <sup>-11</sup>
400	1.16 x 10 <sup>-10</sup>

The artificial solid phases used in this work were prepared in the laboratory by pyrolytic methods. Sodalite and noselite were made by heating a mixture of stoichiometric amounts of silicon dioxide and aluminum oxide with excess sodium carbonate and sodium chloride (sodium sulfate in the case of noselite).

Exchange rates were observed with the radiotracer sodium-22 initially present in either the solid phase or the molten phase. Appropriate amounts of sodium chloride and nitrate were weighed into a platinum crucible, and a weighed amount of solid phase was introduced when both solid and flux had reached the operating temperature in the furnace. After the desired time had elapsed the crucible and contents were removed from the furnace and quickly cooled to room temperature. The flux was washed away with water, and the solid sample was dried, weighed, mounted and counted. From the amount of sodium present in the solid and flux and the initial and final activities the amount of exchange taking place could be determined. A rate curve was developed by heating samples for varying lengths of time at the same temperature. Activation energies and diffusion coefficients were determined from these rate curves.

Microfilm \$2.50; Xerox \$4.80. 91 pages.

SYNTHESIS AND PROPERTIES  
OF SUBSTITUTED BORAZOLES

(L. C. Card No. Mic 60-4891)

Gerd Helmut Dahl, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: Riley O. Schaeffer

The study of substitution reactions of B-trichloroborazole with inorganic salts in suitable organic solvents has resulted in the synthesis of B-trithiocyanatoborazole and B-tricyanoborazole. A compound presumed to be B-trinitratoborazole was found to decompose above 0°C to form nitrogen dioxide and unidentified solid products. Other substitution reactions with lithium bromide, mercuric iodide, aluminum bromide, potassium cyanate, magnesium bromide, magnesium perchlorate and sodium or thallium salts of cyclopentadiene failed to produce new compounds either because no reaction took place or decomposition of the products occurred. Attempts to prepare a N-formylborazole by reacting borazole or B-trichloroborazole with anhydrous chloral failed. The reaction of pyridine with B-trichloroborazole lead to a 1:3 adduct,  $B_3Cl_3N_3H_3 \cdot 3pyridine$ , in which the pyridine is presumably attached to the boron atoms. The hydrogen chloride adduct of monochloroborazole was prepared, and its thermal stability was compared to that of the hydrogen chloride adduct of borazole itself.

Numerous experiments were carried out in an attempt to find a procedure which avoids the liberation of the highly toxic and explosive diborane in the reduction of B-trichloroborazole to borazole. Reductions with sodium hydride in the presence of catalytic quantities of sodium borohydride failed. Similarly, the reduction of B-trichloroborazole with organo silanes in the presence as well as in the absence of free radicals was unsuccessful. The reduction of B-trichloroborazole occurred readily in diglyme with sodium borohydride in the presence of tri-n-butylamine which entirely complexed the diborane formed. Yields of 46% were achieved by this method. Borazole was found to add three moles of acetic acid per mole of borazole to give a solid adduct, presumably similar to other borazole adducts reported earlier in the literature. A reaction between decaborane and borazole in the absence of a solvent was not observed.

The isotopic exchange of borazole with various compounds containing deuterium was studied. Deuterated ammonia, deuterium chloride, and deuterium cyanide were found to exchange with hydrogen on the nitrogen atoms in borazole. No exchange was observed between borazole and deuterated ethanol and deuterium oxide. No exchange and no chemical reactions were detected with deuterium sulfide, deuterated acetylene, and deuterated phosphine. Deuterium, deuterated diborane and deuterated sodium borohydride were found to exchange with the hydrogen on the boron atoms in borazole. Possible mechanisms for the exchange reactions are discussed. Various deuterated borazoles were synthesized and their infrared spectra obtained and interpreted. Mass spectrometric investigation of borazole and B-deuterated borazole lead to the conclusion that a hydrogen atom is abstracted preferentially from boron atoms in the mass spectrometer to give the  $B_3N_3H_5^+$  fragment.

Microfilm \$2.50; Xerox \$4.60. 87 pages.

INTERACTIONS OF PRASEODYMIUM  
AND NEODYMIUM METALS WITH  
THEIR MOLTEN CHLORIDES AND IODIDES

(L. C. Card No. Mic 60-4892)

Leonard Frederick Druding, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: John D. Corbett

The phase diagrams of praseodymium and neodymium chlorides and iodides with their respective metals have been studied by high temperature equilibrations and cooling curves. These measurements were made in tantalum crucibles in an evacuated apparatus. The trichlorides have been prepared by reaction of the metal with anhydrous HCl in molybdenum boats while the triiodides have been prepared by direct reaction of the metal with iodine in tungsten crucibles in an evacuated apparatus. The compounds found in these systems are summarized in Table 1.

Table 1. Summary of results

System	Compound	m.p.*	Limit of mole% M in molten $MX_3^*$
Nd-NdCl <sub>3</sub>	NdCl <sub>3</sub>	758°	30.5, 870°
	NdCl <sub>2.37</sub>	680 ± 3° i	
	NdCl <sub>2.27</sub>	702 ± 2° i	
	NdCl <sub>2.00</sub>	841° i	
Nd-NdI <sub>3</sub>	NdI <sub>3</sub>	787°	36.7, 800°
	NdI <sub>1.95</sub>	562°	
Pr-Pr-Cl <sub>3</sub>	PrCl <sub>3</sub>	786°	18.7, 780°
	PrCl <sub>2.3</sub>	659° i	
Pr-PrI <sub>3</sub>	PrI <sub>3</sub>	736°	28.3, 800°
	PrI <sub>2.50</sub>	676°	
	PrI <sub>2.01</sub>	758° i	

\* - ± 1° and ± 0.1% unless otherwise noted

i - incongruently melting

The composition of the lower praseodymium chloride given represents only the maximum chloride to metal ratio; this compound disproportionates to metal and trichloride below 594°. NdCl<sub>2</sub> is isomorphous with SmCl<sub>2</sub> and EuCl<sub>2</sub> (PbCl<sub>2</sub> structure) while NdI<sub>1.95</sub> is isomorphous with SmBr<sub>2</sub> and EuBr<sub>2</sub> (SrBr<sub>2</sub> structure). From the very metallic appearance of PrI<sub>2</sub>, it is suspected that praseodymium enters the lattice as  $Pr^{+++} + e^-$  rather than as  $Pr^{++}$ ; such behavior has been noted for CeS and Ce<sub>3</sub>S<sub>4</sub>. A similar behavior might account for the apparent reduction of neodymium below the divalent state in NdI<sub>1.95</sub>,  $Nd^{++} + e^-$  being formed to a limited extent, otherwise the possibility of Nd<sup>+</sup> would explain this composition.

Experiments with the mixed cerium-neodymium chloride system indicate that it is possible to put a reduced cerium species in a lattice isostructural with NdCl<sub>2.37</sub> where the neodymium is presumed to be present as Nd<sup>++</sup>. This implies the formation of Ce<sup>++</sup>, and therefore contradicts previous interpretations of the Ce-CeCl<sub>3</sub> system.



Also noted is that small additions of  $\text{Ce}^{+++}$  to  $\text{NdCl}_2$  ( $\text{Nd/Ce} = 4-6$ ,  $\text{Cl/M} = 2.20$ ) result in a phase with an undistorted fluorite structure. Similar behavior is also noted for the praseodymium-neodymium chloride system.

Estimated heats of formation of  $\text{NdCl}_2$ ,  $\text{PrCl}_2$ ,  $\text{NdI}_{1.95}$ , and  $\text{PrI}_{2.01}$  and X-ray powder pattern data for all of the subhalides, triiodides, and  $\text{SmCl}_2$  are reported.

The conclusions reached are that the stability of the divalent state appears to increase as one approaches the stable electronic configuration of the half-filled 4f shell at  $\text{Eu(II)}$  and  $\text{Gd(III)}$ . Neodymium forms stable dihalides, while for praseodymium, only the "diiodide" is stable. Questions concerning the nature of the bonding in the lower halides need further clarification. Predictions are also made concerning the stability of the lower bromides of the light lanthanons, the chlorides and iodides of the heavy lanthanons, and the lower halides of promethium.

Microfilm \$2.50; Xerox \$4.40. 84 pages.

#### REPLACEABILITY OF FIXED AMMONIUM IN CLAY MINERALS

(L. C. Card No. Mic 60-5877)

Arthur Pearson Edwards, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: A. D. Scott

Studies were carried out on the replaceability of  $\text{NH}_4$  adsorbed by trioctahedral (vermiculite) and dioctahedral (illite and montmorillonite) clay minerals from natural deposits. The illite and montmorillonite samples were heated at  $450^\circ\text{C}$  to remove their native nitrogen prior to  $\text{NH}_4$  saturation. Potassium was also removed from some of the mineral samples before they were  $\text{NH}_4$  saturated by a degradation procedure involving the use of sodium tetraphenylboron as a K precipitant.

In equilibrium extractions of illite and vermiculite with salts and resins, the amount of  $\text{NH}_4$  in the solution phase was primarily responsible for determining the amount of  $\text{NH}_4$  removed. Complete displacement of interlayer  $\text{NH}_4$  in the two days was possible only where K and  $\text{NH}_4$  concentrations in solution were maintained at very low levels. The greater effectiveness of Na-saturated resins compared to NaCl was shown to be the result of lower concentrations of fixable cations in solution where the resins were used. Although qualitatively illite and vermiculite behaved similarly, the quantities of  $\text{NH}_4$  and K required to block further  $\text{NH}_4$  removal were greater in the case of vermiculite.

The interlayer  $\text{NH}_4$  in trioctahedral vermiculite was much more readily displaced by H than by Na, whereas the removal of the  $\text{NH}_4$  in dioctahedral illite was relatively unaffected by changes in the acidity of the resins or salt solutions. The temperature of the extracting solution also affected the two clay minerals differently, resulting in a pronounced negative effect on the amount of  $\text{NH}_4$  displaced from vermiculite in contrast to a slight positive influence with illite.

Subdivision of the coarse vermiculite increased the amount of  $\text{NH}_4$  which was exchangeable to K and increased the ratio of fixable to extracting cations required to block further release of  $\text{NH}_4$ .

Montmorillonite in the form of Wyoming bentonite did not fix appreciable amounts of  $\text{NH}_4$  unless heated to  $350^\circ\text{C}$  in the  $\text{NH}_4$ -saturated state. The acid clay resulting from this treatment contained  $\text{NH}_4$  which was much more readily removed as the temperature of the extracting solution was increased. Furthermore, Na salts capable of complexing Al were more effective in displacing this  $\text{NH}_4$  than NaCl or Na-saturated resins. A high pH was necessary for a maximum removal of  $\text{NH}_4$ , but even prolonged distillation in  $\text{H}_2\text{O}$  failed to recover all of the total N present in the heated montmorillonite.

Since the use of HF in procedures to determine total inorganic  $\text{NH}_4$  in soils and clays may lead to high values from the standpoint of potential availability to plants, a method utilizing sodium tetraphenylboron as a K and  $\text{NH}_4$  precipitant in neutral salt solutions was investigated. The use of acetone as a solvent to dissolve the precipitated  $\text{NH}_4$ , followed by a short steam distillation of  $\text{NH}_3$  from the acetone-water mixture, showed promise of permitting rapid estimation of the  $\text{NH}_4$  displaced from illite and vermiculite. However, quantitative recovery of  $\text{NH}_4$  was not achieved from these fixing minerals during the preliminary investigations.

Microfilm \$2.75; Xerox \$12.40. 212 pages.

#### THE RESOLUTION OF OPTICALLY ACTIVE FUNCTIONALLY SUBSTITUTED SILANES AND THEIR APPLICATION TO A STEREOCHEMICAL STUDY OF SUBSTITUTION AT SILICON

(L. C. Card No. Mic 60-5432)

Cecil Leonard Frye, Ph.D.

The Pennsylvania State University, 1960

A practical route to the optically active  $\alpha$ -naphthylphenylmethylsilanes,  $(+)\text{-}\alpha\text{-NpPhMeSiX}$ , has been developed. The resolution, via the selective crystallization of the diastereomeric  $(-)$ -menthoxy-silanes,  $(+)\text{-}\alpha\text{-NpPhMeSi-(-)-OMen}$ , made conveniently available for the first time considerable amounts of optically active organosilicon compounds bearing a labile silicon substituent. The resolved diastereomeric  $(-)$ -menthoxy-silanes were converted to a variety of  $\alpha$ -naphthylphenylmethylsilyl-derivatives by appropriate substitution reactions. Their ready availability and the presence of the labile substituent served to make these compounds eminently suitable for extensive stereochemical study of reactions involving substitution at silicon. Studies such as these have provided the means for an independent evaluation of mechanistic conclusions based upon kinetic data.

By chemical methods, the silanol, disiloxane, methoxy-silane and acetoxysilane were decisively shown to be configurationally similar when of like sign. This information permitted the determination of steric course for a number of nucleophilic displacements at silicon:

- (1) Displacement of the acetate group by methanol or potassium hydroxide to give the methoxy-silane or silanol proceeded invertively.
- (2) In contrast, both the disiloxane and the methoxy-silane were cleaved retentively by potassium hydroxide suspended in xylene.

- (3) Treatment of the methoxysilane with a moist acetone solution of potassium hydroxide yielded disiloxane of inverted configuration.
- (4) Lithium aluminum hydride was shown to react with the acetoxysilane by a steric course opposite to that taken in the reduction of the silanol, disiloxane or methoxysilane. By analogy to the potassium hydroxide cleavages, the reduction of the acetoxysilane is presumably invertive.

Also shown to proceed retentively was the exchange of hydrogen isotopes which resulted from the reaction of (+)- $\alpha$ -NpPhMeSiD and lithium aluminum hydride in boiling di-n-butyl ether.

The reactions of (+)- $\alpha$ -NpPhMeSiCl with water, potassium hydroxide, methanol, sodium trimethoxyborohydride, potassium acetate and (+)- $\alpha$ -NpPhMeSiOK were all shown to follow the same steric course. Such marked insensitivity to the nature of the nucleophile employed strongly suggests that the reactions of the chlorosilane with lithium aluminum hydride, amines, and other bases also follow this particular steric course. Evidence was presented to show that these displacements proceed invertively. If this be true, then it follows rigorously that (+)- $\alpha$ -NpPhMeSiH reacts retentively with chlorine, bromine, or N-bromosuccinimide to give the halosilanes.

The steric course of nucleophilic substitution appears to be largely a function of the relative basicities of the entering and leaving moieties. Furthermore, electrophilic participation of the nucleophile seems to be an important factor leading to retentive displacement. On the basis of such views, a comprehensive configurational correlation was presented and shown to be consistent with the available evidence. This correlation involves the assignment of an invertive path to all nucleophilic displacements upon the chloro-, bromo- and acetoxysilane substrates thus far examined. In contrast all nucleophilic displacements upon the silanol, disiloxane, alkoxysilane and silane substrates in non-polar solvents have been assigned a borderline position; i.e., the steric course of attack upon this substrate is apparently quite sensitive to the nature of the particular nucleophile employed. The following compounds are believed to be configurationally related: (+)- $\alpha$ -NpPhMeSiH, (+)- $\alpha$ -NpPhMeSiD, (+)- $\alpha$ -NpPhMeSiF, (-)- $\alpha$ -NpPhMeSiCl, (-)- $\alpha$ -NpPhMeSiBr, (+)- $\alpha$ -NpPhMeSiOH, (-)- $\alpha$ -NpPhMeSiOK, (+)- $\alpha$ -NpPhMeSi<sub>2</sub>O, (+)- $\alpha$ -NpPhMeSiOMe, (-)- $\alpha$ -NpPhMeSiOC<sub>6</sub>H<sub>11</sub>, (-)- $\alpha$ -NpPhMeSi(-)OMe, (-)- $\alpha$ -NpPhMeSiOCMe<sub>3</sub>, (+)- $\alpha$ -NpPhMeSiOAc, (+)- $\alpha$ -NpPhMeSiNH(i-Bu).

Microfilm \$2.50; Xerox \$8.40. 182 pages.

#### A STUDY OF NONSTOICHIOMETRY IN CRYSTALLINE COMPOUNDS

(L. C. Card No. Mic 60-5229)

Francis Salvatore Galasso, Ph.D.  
The University of Connecticut, 1960

A study has been made of the alkaline earth-group five transition metal-oxygen compounds ( $A_xB_yO_z$ ), where A is strontium or barium and B<sup>V</sup> is niobium or tantalum.

When transition metal ions were substituted for part of the B ions, several phases with the perovskite type structure corresponding to the general formula  $A^{II}(B_x^{II}B_y^{III}B_z^V)O_3$  were prepared, where B<sup>II</sup> = Sr, Ca, Zn, Fe, Co, Ni and B<sup>III</sup> = Co, Fe. A series of similar phases  $A^{II}(Fe_{1-x}^{III}B_x^V)O_{2.5+x}$  were also made where x ranges from 0 to 1/2.

Other new phases produced can be represented by the formulas  $A_{0.44}BO_{2.94}$ ,  $A_{0.5}BO_3$ ,  $A_5B_4O_{15}$  and  $A_3BO_{5.5}$ . The amount of oxygen in compounds of the first three types could be reduced by introducing niobium IV or tantalum IV without changing the structures. In the strontium-niobium-oxygen system the only example of the formula types mentioned in this paragraph which could be prepared was  $Sr_3NbO_{5.5}$ .

The hexagonal phase  $Ba_{0.44}TaO_{2.94}$  was indexed on the basis of a cell with  $a = 8.96\text{\AA}$  and  $c = 7.79\text{\AA}$ . The trial structure can be described as strings of tantalum octahedra joined at corners so as to make groups of three. Three bariums are placed in every other layer not containing tantalum and hold the groups together.

The phase of composition  $Ba_{0.5}TaO_3$  was found to have the tetragonal tungsten bronze structure, the ideal formula for which is  $K_{0.6}WO_3$ . This structure seems to exist with both anion and cation vacancies.

The new ternary oxide of tantalum,  $Ba_5Ta_4O_{15}$  was found to belong to the trigonal system, and was indexed on the basis of a hexagonal cell with  $a = 5.79\text{\AA}$ ,  $c = 11.75\text{\AA}$ . The space group was determined to be  $P\bar{3}m1$ . The structure can be described as a closest packing of oxygens in layers with the layer sequence ABCBC, a barium replacing one oxygen in each layer. The tantalums are in octahedral coordination with oxygen, and the octahedra share corners except for the third and fourth layers of oxygens, which are not shared. All of the cations lie in strings along the  $0,0,z$ ;  $1/3,2/3,z$  and  $2/3,1/3,z$  lines.

The phases prepared with a three to one ratio of barium to tantalum can probably best be shown as related to the perovskite structure by writing the formula as  $Ba(Ba_{1/2}Ta_{1/2})O_{2.75}$ . These phases have an ordered perovskite structure which requires a doubling of the cell edge of the simple  $4\text{\AA}$  perovskite. Phases produced with this composition are soluble in water, while the other phases could only be dissolved by fusions.

Microfilm \$2.50; Xerox \$5.00. 98 pages.

#### PREPARATION AND REACTIONS OF POTASSIUM SILYL

(L. C. Card No. Mic 60-4298)

Morey Abraham Ring, Ph.D.  
University of Washington, 1960

Chairman: David M. Ritter

Clear colorless crystals of potassium silyl and its hemi 1-2 dimethoxyethane solvate have been isolated from solutions obtained by treating silane with potassium or disilane with potassium or potassium hydride.

The reaction between silane and potassium follows two



paths, one yielding hydrogen and the other potassium hydride. The two modes of reaction have been explained in terms of the theories of the structure of metal solutions and the valence theory for the silicon hydrides.

The reaction between disilane and potassium hydride has been shown by hydrogen-deuterium exchange reactions to be part of an equilibrium system in which conversion to potassium silyl and silane is almost complete.

Potassium silyl reacts quantitatively with hydrogen chloride and methyl chloride to produce silane and methylsilane respectively. At 240°, it decomposes rapidly into one and one half moles of hydrogen per mole of sample.

Lithium hydride with disilane gave a solid product which was slightly soluble in 1-2 dimethoxyethane, only slightly reactive with water, and unreactive with hydrogen chloride. The lesser reactivity of lithium silyl, than what is observed for potassium silyl, has been attributed to more covalent character in the lithium-silicon bond.

Preliminary studies have been made of the reactions between potassium silyl and trideuterobromosilane, silicon tetrabromide and diborane.

Microfilm \$2.50; Xerox \$3.00. 52 pages.

**PART I: THE INTERACTION OF  
BIS-(2-METHYL-2-AMINO-3-BUTANONE OXIME)  
AQUONITROCOBALT(III) WITH NITRITE ION.  
PART II: THE REDUCTION OF DECAAMMINE-  
μ-PEROXOCOBLT(III)-COBALT(IV) NITRATE.**

(L. C. Card No. Mic 60-5252)

Ludwig Edward Seufert, Ph.D.  
The University of Connecticut, 1960

**Part I.** The reaction between transnitroquo-bis-(2-methyl-2-amino-3-butanone oxime) cobalt(III) nitrate and nitrite ion was studied. Spectral studies on cobalt(III) compounds of the above mentioned chelating agent showed that the non-chelated groups were labile to substitution. Rate measurements on the above mentioned reaction indicate that it is first order in complex and in nitrite ion over the pH range 4.1 to 8.5.

**Part II.** The reduction of decaammine-μ-peroxo-cobalt(III)-cobalt(IV) nitrate was studied in buffered solutions using various reducing agents.

It was found that the complex, on reaction with nitrite and iodide ions, was reduced via a one electron transfer. The order with respect to the nitrite ion was approximately one while the order with respect to the iodide ion was between one and two. The rate of reduction of the complex by nitrite and iodide ions was found to be hydrogen ion dependent. This was interpreted to mean that the complex was the dissociation product of a weak acid which protonates the peroxo-linkage symmetrically.

Evidence was obtained for a cobalt(II) citrate complex which reduced the cobalt(III)cobalt(IV) complex via a reaction which was zero order in the cobalt(III)cobalt(IV) complex.

Evidence was obtained for photochemical reactions between the complex and both iodine and tris-bipyridyl-ruthenium(II).

Finally, it was found that a neutral salt, sodium per-

chlorate, catalyzes the decomposition of the complex in buffered solutions above pH five.

Microfilm \$2.50; Xerox \$6.80. 142 pages.

**A QUANTITATIVE STUDY OF THE COMPLEXES  
FORMED BETWEEN THE METHYLAMINES  
AND VARIOUS METAL CATIONS: HIGH SPEED  
CALCULATION OF STABILITY CONSTANTS  
BY MEANS OF THE DIGITAL COMPUTER.**

(L. C. Card No. Mic 60-6132)

Judith Ann Symon Sophianopoulos, Ph.D.  
Purdue University, 1960

Major Professor: Derek A. Davenport

Digital computers have been used for exact, high speed solution of simultaneous linear equations whose unknowns are stability constants. One purpose of the present investigation was to prepare a computer program which would not only provide exact, high speed solution of the simultaneous equations which are expanded forms of Bjerrum's formation function, but require only "raw" pH titration data to do so.

The computer program (no. 1013, filed in Purdue Computing Laboratory) prepared in this study is designed for the rapid (< 1 minute) conversion of up to 20 [pH-ml. base] pairs into from two through six least squares stability constants. In addition to values of the stability constants, the program provides for intermediate "print-out" of pairs of  $\bar{n}$  and  $p(A)$  with which to trace the Bjerrum formation curve.

A second purpose of the present work was to study the effect of temperature on formation constants of complexes formed between silver(I) and the methylamines in aqueous solution, this study to be supplemented where possible by measurements of stability constants of complexes of the methylamines and other metal cations. Few previous investigations of the effect of temperature on relative basicity of amines have been made. The present study was prompted by consideration of the importance this effect is likely to have.

Using computer program no. 1013, the time necessary for calculating  $\bar{n}$ 's and  $p(A)$ 's alone was reduced by a factor of 500 compared to desk calculator computations. An even greater per cent reduction in time spent calculating stability constants was achieved.

Values of  $\bar{n}$ ,  $p(A)$ , and successive formation constants for silver(I)-mono-, di-, and trimethylamine systems were calculated by the computer from pH titration data obtained at ionic strengths 0.05, 0.10, 0.16, 0.25, and 1.09 at 10.34°C., 20.09°C., and 30.15°C. A maximum coordination number of two was found for silver(I) complexes with the methylamines. Log  $k_2$  proved to be greater than log  $k_1$  for all systems studied. The following ionic strength and temperature effects were found:

1. The effect of ionic strength on the formation constants is non-linear, varying from small in the methylamine system to appreciable in the trimethylamine system.

2. The effect of increasing temperature on  $\log \beta_2$  changes in direction as amine in the silver system varies from  $\text{MeNH}_2$  to  $\text{Me}_2\text{NH}$  to  $\text{Me}_3\text{N}$ :  $\log \beta_2\text{MeNH}_2$  decreases,  $\log \beta_2\text{Me}_2\text{NH}$  decreases slightly,  $\log \beta_2\text{Me}_3\text{N}$  increases.
3. In the methylamine system, the variation of  $\log \beta_2$  with  $1/T$  is essentially linear, but results from a combination of different, non-linear curves of  $\log k_1$  and  $\log k_2$  vs  $1/T$ . The curve of  $\log k_1$  vs  $1/T$  has a maximum at  $20^\circ$  in the temperature range  $10^\circ$  to  $30^\circ$ .

The temperature effects are discussed from the standpoint of solvation, particularly of temperature induced structural changes in water.

Microfilm \$2.50; Xerox \$8.20. 179 pages.

## CHEMISTRY, ORGANIC

### I. AN IMPROVED GAS-LIQUID CALORIMETER AND A COMPARISON WITH PREVIOUS MODELS.

#### II. BUTTRESSING EFFECT IN 2-METHYL-3-t-BUTYLPYRIDINE AND 2,6-DIMETHYL-3-t-BUTYLPYRIDINE.

(L. C. Card No. Mic 60-6094)

Shelton Bank, Ph.D.  
Purdue University, 1960

Major Professor: Herbert C. Brown

An improved gas-liquid calorimeter has been developed which can be used in connection with a high vacuum apparatus for measuring the heats of reaction of air sensitive gases with solutions. This calorimeter (Graves model) which utilizes a thin wall glass reaction chamber was compared with previous models which employed platinum reaction chambers.

The known advantages of glass over platinum were realized in that the effective thermal leakage modulus of the Graves model was significantly lower than that of a corresponding platinum model. The values were determined to be,  $K = -3.41 \times 10^{-3}$  deg./min./deg. for the Graves model and  $K = -4.42 \times 10^{-3}$  deg./min./deg. for the platinum Olcott model. It is significant that the use of a thin wall glass reaction chamber gives values for the heat capacity and thermal lag not only comparable but superior to those of a platinum model (Graves, Cp,  $2.37 \pm 0.07$  cal./deg.; Olcott, Cp,  $3.58 \pm 0.06$  cal./deg.).

The values for the heat of reaction of boron trifluoride gas with a nitrobenzene solution of pyridine have been determined to be in good agreement for all calorimeters. This permits a direct correlation of the extensive data obtained in the earlier models with data from continued studies in the Graves model.

The Graves calorimeter was applied to a study of the buttressing effect. The buttressing effect is defined as a repulsive interaction between two groups such that the

steric requirements of one of the groups in the vicinity of the reaction center is increased.

Since the electrical effects in a 2-methyl-5-alkylpyridine are similar to those in a 2-methyl-3-alkylpyridine, a comparison of the stabilities of their addition compounds gives a quantitative estimation of the buttressing effect.

The Graves model was tested experimentally by the determination of the buttressing effect in 2,3-lutidine. The heat of reaction of boron trifluoride gas with nitrobenzene solutions of 2,5-lutidine and 2,3-lutidine have been determined to be  $32.54 \pm 0.18$  kcal./mole and  $32.02 \pm 0.11$  kcal./mole respectively. The difference between these values, 0.52 kcal./mole agrees well with the value of 0.6 kcal./mole obtained in the liquid-liquid calorimeter.

The heat of reaction of boron trifluoride gas with a nitrobenzene solution of 2-methyl-5-t-butylpyridine was determined to be  $32.53 \pm 0.13$  kcal./mole. Under the same conditions the heat of reaction of boron trifluoride gas with 2-methyl-3-t-butylpyridine was determined to be  $30.32 \pm 0.11$  kcal./mole. The difference between these values, 2.21 kcal./mole, is the buttressing strain in 2-methyl-3-t-butylpyridine.

A summary of all the rate and equilibrium data for the series of pyridine bases used to study the buttressing effect is given. The relationships between the strengths of the pyridine bases and their heats and rates of reaction with reference compounds of varying steric requirements conclusively demonstrate the buttressing effect as an example of a real steric effect.

The heat of reaction of 2,6-dimethyl-3-t-butylpyridine with gaseous boron trifluoride was determined to be  $23.22 \pm 0.12$  kcal./mole. In line with earlier observations that diortho substitution produces greater steric strain, the buttressing effect in this compound is 3.6 kcal./mole.

Microfilm \$2.50; Xerox \$6.40. 132 pages.

## DEUTERATION OF AROMATIC COMPOUNDS

(L. C. Card No. Mic 60-5592)

William David Blackley, Ph.D.  
University of Minnesota, 1960

Adviser: Dr. Walter M. Lauer

The partial rate factors for hydrogen-deuterium exchange in toluene (1) and other monoalkylbenzenes (2) have been reported by Lauer, Matson and Stedman. The partial rate factors for t-butylbenzene have been determined by Koons (3). The relative rates of hydrogen-deuterium exchange of the polymethylbenzenes have been reported by Lauer and Stedman (4). The present work is a continuation of this study.

The partial rate factors for isopropylbenzene were determined by dedeuteriation experiments using the ortho-, meta- and para-deuterioisopropylbenzenes. The corresponding deuteriotoluene was treated at the same time under the same conditions to obtain the relative rates of dedeuteriation. The partial rate factors for isopropylbenzene were found to be:  $o_f = 250 \pm 10$ ,  $m_f = 6.16 \pm .20$  and  $p_f = 483 \pm 21$ . These values are



given relative to benzene in which each position has unit reactivity.

The *meta* partial rate factor of ethylbenzene was determined in a similar manner. The partial rate factor relative to benzene was found to be 4.52.

The reactivities of three polyisopropylbenzenes were obtained relative to the corresponding polymethylbenzenes. The reactivity ratio of 1,3-diisopropylbenzene, 1,4-diisopropylbenzene and 1,3,5-triisopropylbenzene compared to *m*-xylene, *p*-xylene and mesitylene were found to be 1.04, 2.16 and 0.27, respectively.

The reactivities of several polynuclear aromatic compounds relative to *o*-xylene were determined by hydrogen-deuterium exchange reactions. The ratio of their reactivities were found by competitive studies.

The reactivities of biphenylene, fluorene, triphenylene and phenanthrene compared to *o*-xylene were found to be 6.15, 5.85, 1.08 and 1.32, respectively.

The methylene hydrogens of fluorene were shown to be inactive under the reaction conditions used. No hydrogen-deuterium exchange was observed at the methylene carbon. This was shown by analysis after oxidation of the deuterated fluorene to fluorenone.

Exchange was shown to take place exclusively at position 2 in biphenylene. The biphenylene was reduced to biphenyl and the position of the deuterium established by infrared analysis.

Deuterium analysis was made by burning the organic compound to carbon dioxide and water. The water was collected in a dry ice-acetone trap and in turn reduced over zinc at 430°C to hydrogen and deuterium which was collected. The gaseous mixture was then analyzed by a mass spectrometer.

The dedeuteration reactions were conducted in trifluoroacetic acid-water mixtures. The deuteration reactions were carried out using trifluoroacetic acid-deuterium oxide as the solvent. All reactions were carried out in a 70°C constant temperature bath except for the dedeuteration of the *m*-d-isopropylbenzene and *m*-d-Ethylbenzene. The exchange of these two *meta* isomers was carried out at 100°C.

1. W. M. Lauer, G. W. Matson and G. Stedman, *J. Am. Chem. Soc.* **80**, 6433 (1958).
2. W. M. Lauer, G. W. Matson and G. Stedman, *J. Am. Chem. Soc.* **80**, 6437 (1958).
3. C. B. Koons, Thesis, Doctor of Philosophy, University of Minnesota, 1958.
4. W. M. Lauer and G. Stedman, *J. Am. Chem. Soc.* **80**, 6439 (1958).

Microfilm \$2.50; Xerox \$4.40. 82 pages.

#### STERIC EFFECTS OF CARBON CHAINS IN AMINATIONS OF ALLYLIC CHLORIDES

(L. C. Card No. Mic 60-5231)

David Stevens Gifford, Ph.D.  
The University of Connecticut, 1960

The object of this research was to determine the steric effects in amination reactions of various allylic chlorides

containing chains of at least six carbon atoms. It has been shown by previous workers that secondary allylic chlorides containing five atoms in a chain give complete rearrangement on treatment with dimethylamine in a polar solvent, while secondary allylic chlorides containing six atoms in a chain give a partial rearrangement under the same conditions.

The compounds chosen for study were isomeric pairs of allylic secondary and primary chlorides, 3-chloro-1-hexene and 1-chloro-2-hexene, 3-chloro-1-heptene and 1-chloro-2-heptene, 3-chloro-4-methyl-1-hexene and 1-chloro-4-methyl-2-hexene, 3-chloro-5-methyl-1-hexene and 1-chloro-5-methyl-2-hexene, and 3-chloro-6-methyl-1-heptene and 1-chloro-6-methyl-2-heptene.

The experimental determination was based upon measurement of the ratio of normal displacement product to abnormal displacement product as determined by analytical fractional distillation through a Podbielniak column. The results obtained are listed below:

#### RESULTS OF AMINATIONS OF SECONDARY ALLYLIC CHLORIDES RCH(Cl)CH=CH<sub>2</sub> WITH DIMETHYLAMINE

R	% Unre- arranged	% Re- arranged	% Total Yield
CH <sub>3</sub> (CH <sub>2</sub> ) <sub>2</sub> -	29	71	70
CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> -	53	47	45
CH <sub>3</sub> CH <sub>2</sub> C(CH <sub>3</sub> )H-	trace	99	38
(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> -	14	86	50
(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> CH <sub>2</sub> -	49	51	69

These results are not easily rationalized in terms of any known theory, but an explanation is given based on hydrogen bond formation between the hydrogen attached to the terminal carbon atom and the chlorine attached to the allylic carbon atom to form in effect a six-membered ring. This then assists in the removal of the chlorine atom which gives rise to unrearranged products.

Microfilm \$2.50; Xerox \$4.20. 76 pages.

#### THE INVESTIGATION OF THE STERIC EFFECTS AFFORDED BY SELECTED SULFONYL CHLORIDES

(L. C. Card No. Mic 60-4701)

Martin Jay Gordon, Ph.D.  
University of Alabama, 1960

As a methyl group in the alpha position is quite effective in hindering ethanolysis of an aliphatic sulfonyl chloride, it was supposed that a methyl group in the beta position or one more distantly situated would have decreased influence on reactions of sulfonyl chlorides with bases having steric requirements no greater than those of ethanol. Also, it was thought that a gamma chlorine substituent, which should show about the same steric requirements as a methyl group, would exert no appreciable influence of a polar nature on the ethanolysis of an aliphatic sulfonyl chloride. 2,2-Dimethyl-1-butanefulfonyl

chloride and 2,2-dimethyl-4-butanefonyl chloride having two beta and two gamma methyl groups, respectively, and 3-chloro-1-propanesulfonyl chloride were used as models to test the validity of these assumptions.

The rates of ethanolysis of 2,2-dimethyl-1-butane-, 2,2-dimethyl-4-butane-, and 3-chloro-1-propanesulfonyl chlorides and the rate of alkylation of ethanolic hydrogen chloride by ethyl 2,2-dimethyl-4-butanefonyl chloride were determined at various temperatures. It was shown that 2,2-dimethyl-4-butanefonyl chloride undergoes ethanolysis at about the same rate as that determined for a normal unbranched compound such as 1-octanesulfonyl chloride, thereby verifying the assumption that gamma methyl groups are ineffective in hindering ethanolysis. When the rates of ethanolysis of 2,2-dimethyl-1-butane- and 2-octanesulfonyl chlorides are compared, it was shown that the two methyl groups in the beta position offer the same steric requirement to ethanolysis as the one alpha methyl substituent. Also, it was shown that the gamma chlorine atom of 3-chloro-1-propanesulfonyl chloride only provides a slight increase in the steric requirement towards ethanolysis over that afforded by a normal unbranched sulfonyl chloride. This slight increase might be attributed to the fact that a chlorine atom is slightly larger than a methyl group.

The aliphatic sulfonic acid esters were discussed in the light of Newman's six-number effect. A transition state was proposed for the alkylation of hydrogen chloride and lithium chloride by ethyl alkanesulfonates which showed how a beta methyl substituent markedly decreased the rate of reaction of the ethyl ester because of the increased six-number.

The following is a list of the new compositions of matter prepared in this research: 2,2-dimethyl-4-butanefonyl chloride, 2,2-dimethyl-4-butanefonyl fluoride, 2,2-dimethyl-4-butanefonylbenzylamide, 2,2-dimethyl-4-butanefonylmorpholide, 2,2-dimethyl-4-butanefonylamine, 2,2-dimethyl-4-butanefonyl-n-propylamide, 2,2-dimethyl-4-butanefonylisopropylamide, 2,2-dimethyl-4-butanefonyl-n-butylamide, 2,2-dimethyl-4-butanefonylisobutylamide, 2,2-dimethyl-4-butanefonylcyclohexylamide, ethyl 2,2-dimethyl-4-butanefonylsulfonate, 2,2-dimethyl-1-butanefonyl chloride, 2,2-dimethyl-1-butanefonylbenzylamide, 2,2-dimethyl-1-butanefonylmorpholide, and ethyl 3-chloro-1-propanesulfonate. Microfilm \$2.50; Xerox \$7.00. 148 pages.

#### STRUCTURE STUDIES ON GELSEMINE

(L. C. Card No. Mic 60-4896)

John Holmes Hansen, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: Dr. E. Wenkert

A series of experiments to elucidate the structure of gelsemine, an oxindole alkaloid, has been described. Although no final proof of structure was reached, several new derivatives of gelsemine have been characterized.

Two new products of hydration of the vinyl group of the alkaloid, isomers of previously reported hydration products seem to be epimers. The less stable of these prod-

ucts is converted to the other by pyrolytic, strongly basic or acidic conditions. Oxidation of these hydration products did not lead to controlled degradation of gelsemine.

The lactam ring of gelsemine was cleaved by a new method. Tosylation of the lactam nitrogen atom produced a toluenesulfonimide which was readily hydrolyzed to an acid or cleaved reductively to a primary alcohol. Although further, controlled degradation of gelsemine was not achieved via these derivatives the method may be of value for other oxindole compounds.

Extension of a method used earlier with gelsemine allowed reductive cleavage of the tertiary amine ring. Although no well-characterized products were obtained, the method may be of value for degradation of amines in cases where the Emde reduction is not feasible.

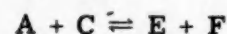
Microfilm \$2.50; Xerox \$5.60. 112 pages.

#### THE RELATIVE REACTIVITIES OF SOME ALKYL MERCURIC IODIDES TOWARD AQUEOUS NON-HALOGEN ACID AND A QUANTUM MECHANICAL STUDY OF METHYL ANION

(L. C. Card No. Mic 60-5160)

Richard LaVerne Hansen, Ph.D.  
University of Minnesota, 1960

The kinetics and mechanism of the reactions of ethyl, n-propyl, n-hexyl, cyclopropyl, iso-propyl and t-butylmercuric iodides with aqueous sulfuric or perchloric acid to produce the corresponding hydrocarbons and mercuric salts have been investigated. The reactions were conducted using aqueous solutions containing 2% - 6% methanol. An integrated rate law for the following system is derived.



A linear acid dependence was observed in all cases studied. Studies of the reaction rates as a function of temperature in the range 40° C. - 150° C. allowed calculation of the heats and entropies of activation. In the cases of ethyl, n-propyl and iso-propyl mercuric iodides these properties were the same within the allowed uncertainties with  $\Delta H^\ddagger = 23$  kcal./mole and  $\Delta S^\ddagger = -23$  e.u. These results are comparable with those found previously for the reaction of methylmercuric iodide under the same conditions and it is proposed that the transition states in these three cases are essentially the same as that postulated for the reaction of methylmercuric iodide.<sup>1</sup> That is, a transition state in which the carbon-mercury bond is very stretched while the proton transfer from oxygen to carbon is just beginning.

In the case of cyclopropylmercuric iodide  $\Delta H^\ddagger = 20.9 \pm 1.4$  kcal./mole and  $\Delta S^\ddagger = -11 \pm 4$  e.u. A solvent isotope effect,  $k_{D_2O}/k_{H_2O} = 0.6 \pm 0.1$ , was found on changing the solvent from H<sub>2</sub>O to D<sub>2</sub>O. The latter is consistent with a transition state in which the proton transfer from oxygen to carbon is more complete in this case than for other members in the series. The observed heat and entropy of activation suggest that the transition state is



more compacted in the case of cyclopropylmercuric iodide than that for others in the series. In the cases of *n*-hexyl and *t*-butylmercuric iodides the kinetic order with respect to acid and the temperature dependence of the rate were not determined. The observed relative reactivities at 110° C. and 1.0 M. acid concentration together with that found for the methyl analog are as follows:

cyclopropylmercuric iodide	4000
methylmercuric iodide	1.0
ethylmercuric iodide	0.4
<i>n</i> -propylmercuric iodide	0.2
<i>n</i> -hexylmercuric iodide	about 0.2
iso-propylmercuric iodide	0.08
<i>t</i> -butylmercuric iodide	< 0.05

It was found that iso-propyl and *t*-butylmercuric iodides reacted with oxygen dissolved in the solvent at 100°. This reaction was also briefly investigated. In the case of iso-propylmercuric iodide a study of the temperature dependence of the reaction showed that the heat of activation was almost zero between 110° and 133° C. In the case of *t*-butylmercuric iodide it was found that only trace amounts of oxygen were required. A mechanism consistent with the observed facts is presented and a general mechanism for the reaction of organo-metallic compounds with oxygen is proposed.

The configuration of methyl anion has been investigated theoretically using the molecular orbital theory and approximations to atomic integrals. A method for determining numerical values of atomic resonance integrals is described. Results of calculation indicate that the bond angles in methyl anion are between 90° and 109°. The barrier to planarity in methyl anion is predicted to be about 23 kcal./mole. Calculation by the same method used for the anion predicts that the bond angles in methyl radical are approximately 109°.

The ultraviolet spectra of the alkylmercuric iodides studied are shown graphically in the region 1900 Å - 3000 Å.

1. M. M. Kreevoy, J. Am. Chem. Soc., 79, 5927 (1957). Microfilm \$2.50; Xerox \$6.80. 142 pages.

#### THE PYROLYSIS OF 2-(N-β-ACYLOXYETHYL-ANILINO)-4,6-DIALKOXY-S-TRIAZINES AND RELATED COMPOUNDS.

(L. C. Card No. Mic 60-4841)

Jerome Hollander, Ph.D.

The University of North Carolina, 1960

Supervisors: Richard G. Hiskey and Joseph F. Bunnett

The investigation concerned several new examples of pyrolytic dealkylations in the triazine series and also the mechanistic nature of the reaction. Pyrolysis of 2-(N-β-acetoxyethyl-anilino)-4,6-dimethoxy-s-triazine at 200-250° for 2.5 hours afforded a 75% yield of 2-N-vinyl-

anilino-4-hydroxy-6-methoxy-s-triazine and 62.3% of methyl acetate. Likewise 2-(N-β-n-butyroxyethyl-anilino)-4,6-diethoxy-s-triazine pyrolyzed to 2-N-vinylanilino-4-hydroxy-6-ethoxy-s-triazine and ethyl butyrate, and 2-(N-β-benzoyloxyethyl-anilino)-4,6-dimethoxy-s-triazine gave 2-N-vinylanilino-4-hydroxy-6-methoxy-s-triazine and methyl benzoate on pyrolysis.

In order to distinguish between an intramolecular and an intermolecular process, a mixture of 2-(N-β-acetoxyethyl-anilino)-4,6-dimethoxy-s-triazine and 2-(N-β-n-butyroxyethyl-anilino)-4,6-diethoxy-s-triazine was pyrolyzed. The resulting mixture of esters was collected and identified using a vapor fractometer. The results, which indicated the mixture consisted of approximately equal parts of methyl acetate, ethyl acetate, methyl *n*-butyrate, and ethyl *n*-butyrate, suggested an intermolecular path for the pyrolysis. Further evidence for the intermolecular nature of the reaction was obtained by the pyrolysis of 2-(N-β-n-butyroxyethyl-anilino)-4,6-dimethoxy-s-triazine in the presence of an equal amount of sodium acetate. The vapor fractogram of the ester fraction indicated methyl acetate and methyl *n*-butyrate were present. Likewise, pyrolysis of 2-(N-β-acetoxyethyl-anilino)-4,6-dimethoxy-s-triazine with added sodium phenoxide, yielded methyl acetate and anisole.

The formation of a free acid anion in the pyrolysis was further substantiated by the decomposition of oxygen-18 labeled 2-(N-β-acetoxyethyl-anilino)-4,6-dimethoxy-s-triazine. Analysis of the labeled methyl acetate obtained from the pyrolysis showed all of the oxygen-18 was present in the methyl acetate. Hydrolysis of the labeled methyl acetate and analysis of the resulting methanol for oxygen-18 content indicated the oxygens had undergone complete equilibration. Control experiments indicated equilibration of oxygen-18 labeled methyl acetate did not occur during hydrolysis or when subjected to conditions similar to those of the pyrolysis.

Pyrolysis of 2-(N-β-hydroxyethyl-anilino)-4,6-dimethoxy-s-triazine yielded 2-N-vinylanilino-4-hydroxy-6-methoxy-s-triazine and methanol. Pyrolysis of the *p*-toluenesulfonate ester of 2-(N-β-hydroxyethyl-anilino)-4,6-dimethoxy-s-triazine yielded 2-N-vinylanilino-4,6-dihydroxy-s-triazine and methyl-*p*-toluene-sulfonate.

When 2-(N-β-acetoxyethyl-anilino)-4,6-dimethoxy-s-triazine was pyrolyzed in aqueous ethylene glycol solution, the products were 2-N-vinylanilino-4,6-dihydroxy-s-triazine and acetic acid. Trimethoxy-s-triazine was cleaved by acetic acid, yielding methyl acetate. These results indicate that acetic acid is never free in the dry pyrolysis of acetoxyethyl-anilino-dialkoxy-s-triazines. Pyrolysis of diphenylaminoethyl acetate at 250° yielded no products, and at 500° yielded 6.1% acetic acid. The high temperature required for the pyrolysis of diphenylaminoethylacetate compared to that required for the pyrolysis of the triazine esters suggested that the nitrogen atom in the triazine ring was assisting in pyrolysis of triazine esters.

The above results are consistent with a mechanism involving abstraction of a hydrogen atom beta to the ester grouping by the nitrogen atom of the triazine ring yielding an intermediate triazinium salt. The salt may then decompose by nucleophilic attack of the anion on the carbon atom of the methoxy group in a bimolecular decomposition.

In order to further substantiate that the nitrogen atom in the triazine ring was assisting the pyrolysis, an attempt

was made to prepare 2-(N- $\beta$ -hydroxyethyl-anilino)-pyridine by reaction of 2-bromopyridine and N-phenylethanolamine. The product, however, was proven to be N-( $\beta$ -anilino-ethyl)-2-pyridone. This compound on acetylation yielded N-( $\beta$ -acetanilinoethyl)-2-pyridone.

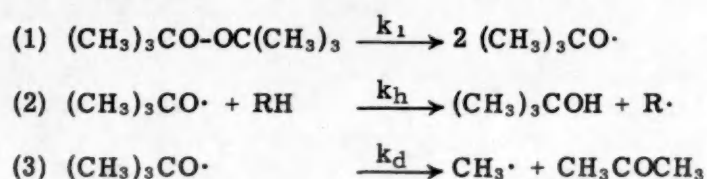
Microfilm \$2.50; Xerox \$3.80. 67 pages.

#### A STUDY OF FACTORS WHICH AFFECT FREE RADICAL REACTIVITY

(L. C. Card No. Mic 60-5235)

Daniel James Hurley, Ph.D.  
The University of Connecticut, 1960

The decomposition of *tert*-butyl peroxide in the presence of a solvent proceeds by the following mechanism:<sup>1</sup>



The amount of *tert*-butyl alcohol and acetone produced by reactions (2) and (3) is a measure of the ease of abstraction of a hydrogen atom from RH by a *tert*-butoxy radical relative to the rate of *tert*-butoxy radical decomposition ( $k_h/k_d$ ).<sup>1</sup>

In the present study,  $k_h/k_d$  values for a number of carbon-hydrogen bonds were determined. The method involved the decomposition of *tert*-butyl peroxide in a number of compounds neat and in benzene, and a measurement by gas chromatography of the amounts of *tert*-butyl alcohol and acetone produced. The results are listed in the following table.

TABLE I

Compound	$k_h/k_d$ at 135 °a	$k_h/k_d$ at 135 ° in benzene <sup>a</sup>
benzene	0.0042	0.0042
toluene	0.067	0.065
ethylbenzene	0.24	0.26
propylbenzene	0.35	0.31
isopropylbenzene	0.42	0.43
isobutylbenzene	0.21	0.27
neopentylbenzene	0.19	0.22
pyridine	0.012	0.020
2-picoline	0.011	0.014
3-picoline	0.031	0.049
4-picoline	0.013	0.019

<sup>a</sup>Values refer to the alpha hydrogen except for benzene and pyridine where they refer to nuclear hydrogens.

The different values obtained when the compounds were run alone and in benzene indicates that the solvent can

affect the course of a free radical reaction. This effect is attributed to the formation of a complex between the radical and the  $\pi$ -electrons of the aromatic nucleus. The lower value of  $k_h/k_d$  for neopentylbenzene compared to the values of the other alkylaromatics is attributed to steric factors. Comparison of the  $k_h/k_d$  values of the heterocyclic aromatics with the other compounds points to the large influence of polar effects on the free radical reaction. Various mechanisms for hydrogen abstraction from pyridine are discussed.

In addition, the dimers resulting from hydrogen abstraction from the methyl group of 2-, 3-, and 4-picoline were isolated and characterized. The site of attack of the *tert*-butoxy radical on the pyridine ring was partially determined by decomposing *tert*-butyl peroxide in 2-deutero and 3-deuteropyridine. An infrared analysis of the amounts of *tert*-butyl alcohol and *tert*-butyl alcohol-O-D formed indicated that hydrogen abstraction had occurred at both the 2- and 3-positions and, presumably, the 4-position of pyridine.

#### Reference

1. Williams, A. L., Oberright, E. A., and Brooks, J. W., *J. Am. Chem. Soc.*, **78**, 1190 (1956).

Microfilm \$2.50; Xerox \$3.00. 59 pages.

#### OXYGEN-CONTAINING PRODUCTS FROM OXIDIZED DECANE

(L. C. Card No. Mic 60-5445)

David Allan Kurtz, Ph.D.  
The Pennsylvania State University, 1960

About 5550 grams of *n*-decane was allowed to react in an open-tube, continuous flow, non-catalytic process with 1190 grams of oxygen at atmospheric pressure, at a temperature of 425°C., and at a contact time of about five seconds. The products, resulting from a 55 per cent *n*-decane conversion, consisted of an organic layer composed of a mixture of unreacted decane and oxygenated compounds, an aqueous layer containing some water-soluble, low-molecular weight oxygenated products, and a non-condensable gas. The latter two products were ignored in this thesis, and effort was expended solely on the oxygenated materials present in the organic layer, which represented the chief products of the reaction.

The oxygenated compounds in the organic layer were separated from the hydrocarbons (largely as unreacted decane) by silica gel adsorption. In this manner 1366 grams of the oxygenated mixture was separated from the other products. The oxygenated mixture was then separated into a number of portions according to boiling point by means of careful distillations and redistillations through efficient fractionation columns having from 30 to 50 theoretical plates. As many of the products as possible were then isolated and characterized by use of gas chromatography, infrared spectroscopy, derivatives, and other procedures.

About 40 per cent of the oxygenated compounds consisted of ten-carbon-atom products the bulk of which were epoxides. Compounds identified in this mixture were 2,5-dipropyltetrahydrofuran, 2-ethyl-5-butyltetrahydrofuran,



2-methyl-5-pentyltetrahydrofuran, 2-hexyltetrahydrofuran, 2,4-epoxydecane, and 2-decanone. A smaller total amount of material in this portion was unidentified but was assumed to consist of primarily other four-membered-ring epoxides and other decanones.

For these identified compounds it was found that the position of carbon-atom attack in the original oxidation was not centered on any particular carbon atom but was spread out essentially evenly amongst the secondary carbon atoms. The primary carbon atoms received less attack. It was also learned that *cis*- and *trans*-isomers, where possible, were formed in roughly equal amounts.

The oxygenated product mixture of *n*-decane also consisted of about 300 grams (20%) of material boiling, in general, higher than the compounds discussed above. While this product contained esters and carbonyl compounds, no specific compounds were identified in this portion.

The remaining 570 grams (39%) of oxygenated product from the *n*-decane oxidation consisted of at least 75 degraded (lower in boiling point and in carbon content) products. Included in the identified products of this portion were aldehydes, ketones, epoxides, and alcohols.

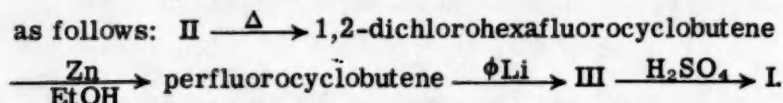
Several alkyl epoxides were prepared to provide synthetic samples used for physical property comparison in unknown compound identification. 2-Ethyl-5-butyl-tetrahydrofuran and 2,5-dipropyltetrahydrofuran were prepared by the alkylation of furan, followed by the hydrogenation of the furan ring. 2,4-Epoxydecane was prepared by the dehydrohalogenation of 2-chloro-4-decanol. Microfilm \$3.45; Xerox \$12.15. 266 pages.

#### SYNTHESIS AND PROPERTIES OF DIPHENYLCYCLOBUTADIENOQUINONE

(L. C. Card No. Mic 60-6454)

Eugene Albert La Lancette, Ph.D.  
Cornell University, 1960

Diphenylcyclobutadienoquinone (I), the dioxo analog of diphenyldimethylenecyclobutene, was easily obtained in a four-step synthesis starting from trifluorochloroethylene (II), the key step being hydrolysis of 1,2-diphenyl-3,3,4,4-tetrafluorocyclobutene (III). The synthetic scheme used is as follows: II  $\xrightarrow{\Delta}$  1,2-dichlorohexafluorocyclobutene



Infrared, ultraviolet and NMR spectra all support the postulated cyclobutenedione structure for I as were the observations that I would be oxidized to benzoic acid (alkaline permanganate) or to diphenylmaleic anhydride via Baeyer Villiger Oxidation with hydrogen peroxide.

Following the noteworthy synthesis of phenylcyclobutadienoquinone by Smutny and Roberts,<sup>1</sup> it was noted that cyclobutenediones were valence tautomers of *bis*-ketenes. Though the initially attempted synthesis of I via a tautomeric shift of *bis*-phenylketene (IV) failed, it is observed that I in ethanolic solution deteriorates to a mixture of *meso* and *racemic* diethyl- $\alpha,\alpha'$ -diphenylsuccinate, presumably via the intermediate IV.

Upon treatment of the diketone I with methanolic

sodium hydroxide, ring opening occurred yielding benzaldehyde together with the benzylidene derivative of phenylpyruvic acid. All of the latter product was isolated as  $\alpha$ -keto- $\beta,\gamma$ -diphenyl- $\gamma$ -butyrolactone.

Lithium aluminum hydride reduction of the quinone I in ether gave *cis*-diphenylcyclobutenediol (V) (23%) and *trans* diphenylcyclobutenediol (3%), whereas reduction in tetrahydrofuran gave only the *trans* isomer (6%).

Attempts to convert I to a 1,2-diphenylcyclobutadiene derivative have failed. Reaction of I with *o*-phenylenediamine results in ring opening and 3-phenylacetyl-2-phenylquinoxaline (VI) is produced. The structure of compound VI was elucidated by chemical and spectroscopic studies.

It is felt that with polyphosphoric acid, an abnormal Beckman Rearrangement of the oxime of VI occurs yielding 2-benzyquino[3,4-*b*]quinoxaline, a new heterocyclic system. Oxidation of VI with chromium trioxide gives benzoic acid 3-phenyl-2-hydroxyquinoxaline and 3-phenylquinoxaline-2-carboxylic acid. Baeyer Villiger Oxidation of VI with peracetic acid in the presence of sulfuric acid gives the same three products.

Upon debrominating 1,2-diphenyl-3,4-dibromocyclobutene (VII), prepared by treating the *cis*-diol V with phosphorus tribromide, using 0.5% lithium amalgam, a crimson oil is obtained from which only traces of a crystalline, non-polymeric substance can be isolated. Debromination with zinc dust produces similar results.

Treatment of VII with lithium amalgam gives presumably an unstable nickel dibromide complex of 1,2-diphenylcyclobutadiene which readily releases an equivalent amount of nickel bromide.

1. E. J. Smutny and J. D. Roberts, J. Am. Chem. Soc., **77**, 3420 (1955).

Microfilm \$2.50; Xerox \$6.40. 133 pages.

#### SULFONE DERIVATIVES OF CYCLOPROPANE AND CYCLOBUTANE

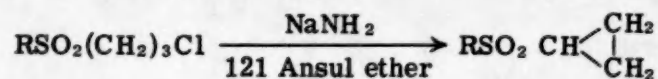
(L. C. Card No. Mic 60-6120)

Lowell Berga Lindy, Ph.D.  
Purdue University, 1960

Major Professor: William E. Truce

#### Part I. Cyclopropyl Sulfones.

Previous attempts<sup>1</sup> at preparing cyclopropyl sulfones have been unsuccessful except for the reported formation of 1,1-*bis*-(ethylsulfonyl)-cyclopropane<sup>2</sup> and phenyl cyclopropyl sulfone.<sup>3</sup> A simple method for the preparation of cyclopropyl sulfones has been developed, independently of but similar to that developed by Zimmerman,<sup>4</sup>



where R is phenyl, *p*-tolyl, *t*-butyl, methyl and benzyl. The structures of the cyclopropyl sulfones were partially established by cleavage reactions. Phenyl and *p*-tolyl cyclopropyl sulfones were cleaved by lithium in methylamine<sup>4</sup>

to yield lithium cyclopropanesulfinate, which was converted into benzyl and methyl cyclopropyl sulfones upon treatment with benzyl chloride and methyl iodide, respectively. *t*-Butyl cyclopropyl sulfone was cleaved with sodium methoxide<sup>5</sup> to give isobutylene and sodium cyclopropanesulfinate. The latter was converted into benzyl cyclopropyl sulfone upon treatment with benzyl chloride. Phenyl cyclopropyl sulfone was desulfurized<sup>6</sup> by Raney nickel in refluxing ethanol to yield cyclopropane.

The following intermediates were prepared:  $\gamma$ -hydroxypropyl sulfides,  $\text{RSCH}_2\text{CH}_2\text{CH}_2\text{OH}$ ;  $\gamma$ -chloropropyl sulfides,  $\text{RSCH}_2\text{CH}_2\text{CH}_2\text{Cl}$ ;  $\gamma$ -chloropropyl sulfones,  $\text{RSO}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$ ; where R is phenyl, *p*-tolyl, methyl, *t*-butyl and benzyl. 2-Phenyl-tetrahydrothiophene-1-dioxide was prepared to show its non-identity with the compound described as being benzyl cyclopropyl sulfone.

Three approaches to cyclopropyl sulfides were attempted but without success, i.e., the method of Simmons and Smith,<sup>7</sup> which involved methylene iodide, zinc-copper couple and a vinyl sulfide, the reduction of cyclopropyl sulfones with lithium aluminum hydride<sup>8</sup> and the  $\gamma$ -dehydrohalogenation of a  $\gamma$ -chloropropyl sulfide with sodium hydride or potassium *t*-butoxide.

Phenyl and *p*-tolyl cyclopropyl sulfones were treated with a variety of electrophilic and nucleophilic reagents in an attempt to open the cyclopropane ring. In each case, the starting cyclopropyl sulfone was recovered. The reagents were 48% hydrobromic acid, 55% hydroiodic acid, 48% hydrobromic acid in glacial acetic acid,<sup>9</sup> sodium benzenethiolate, sodium *t*-butoxide, mercuric acetate and aluminum chloride-acetyl chloride in methylene chloride.

Attempts to produce cyclopropene from cyclopropyl sulfones by heating in the presence of potassium hydroxide or sodium methoxide,<sup>5</sup> were unsuccessful.

Methyl cyclopropyl ketone was found to undergo ring opening when treated with sodium benzenethiolate, the product being  $\gamma$ -(benzenemercapto)-propyl methyl ketone.

## Part II. Cyclobutyl and Cyclopentyl Sulfones.

It was of interest to determine whether cyclobutyl and cyclopentyl sulfones could be formed by analogous delta and epsilon dehydrohalogenations of the corresponding  $\delta$ -chlorobutyl sulfone and  $\epsilon$ -chloroamyl sulfone. Phenyl cyclopentyl sulfone and *p*-tolyl cyclobutyl sulfone were obtained by the above dehydrohalogenations and were prepared independently to prove their structures. *p*-Tolyl cyclobutyl sulfide was prepared for the first time. Heating phenyl cyclopentyl sulfone in the presence of sodium methoxide gave cyclopentene and benzenesulfinic acid.

## BIBLIOGRAPHY

1. L. I. Smith and H. R. Davis, Jr., *J. Org. Chem.*, **15**, 824-31 (1950).
2. E. Rothstein, *J. Chem. Soc.*, 1560-5 (1940).
3. H. Zimmerman and B. S. Thyagarajan, *J. Am. Chem. Soc.*, **82**, 2505 (1960).
4. W. E. Truce, D. N. Burdge and D. P. Tate, *ibid.*, **82**, 2872-6 (1960).
5. G. W. Fenton and C. K. Ingold, *J. Chem. Soc.*, 705 (1930).

6. R. Mozingo, D. E. Wolf, S. A. Harris and K. Folkers, *J. Am. Chem. Soc.*, **65**, 1013 (1943).
7. H. E. Simmons and R. D. Smith, *ibid.*, **81**, 4256-64 (1959).
8. F. G. Bordwell and W. H. McKellin, *ibid.*, **73**, 2252 (1951).
9. R. Fuson and F. N. Baumgartner, *ibid.*, **70**, 3255 (1948). Microfilm \$2.50; Xerox \$7.20. 153 pages.

## PROPERTIES AND REACTIONS OF SOME FLUOROCARBON DERIVATIVES CONTAINING OXYGEN, SULFUR, PHOSPHORUS AND NITROGEN.

(L. C. Card No. Mic 60-5140)

Tzu Jen Mao, Ph.D.  
The University of Florida, 1960

The properties and reactions of some fluorocarbon derivatives containing O, S, P and N were investigated.

Perfluorodiethyl oxide,  $(\text{C}_2\text{F}_5)_2\text{O}$ , was pyrolyzed at 800°C. in a flow system, yielding  $\text{COF}_2$ ,  $\text{C}_2\text{F}_6$ ,  $\text{C}_3\text{F}_8$ ,  $\text{C}_3\text{F}_6$ , *iso*- $\text{C}_4\text{F}_8$  and carbon, as its decomposition products. The conversion, under the given experimental conditions, was in the order of 70%.

The reaction between  $\text{CF}_3\text{SF}_5$  and  $\text{CF}_3\text{C}\equiv\text{CCF}_3$  at 525°C. led to the formation of two new fluorocarbon compounds, namely, perfluoro-2,3,4-trimethylhexadiene-2,4 and perfluoro-2,3,4,5-tetramethylhexadiene-2,4. Some of their chemical and physical properties were determined.

Both  $(\text{PNF}_2)_3$  and  $(\text{PNF}_2)_4$  were prepared at 700°C. by treating  $\text{P}_3\text{N}_5$  with either  $\text{CF}_3\text{SF}_5$  or  $\text{NF}_3$ . Their infrared assignments were presented. These two fluorides reacted with  $\text{H}(\text{CF}_2\text{CF}_2)_3\text{CH}_2\text{ONa}$  to form the corresponding polyfluoroalkyl phosphonitrilates.

N-(Perfluoroacyl)-phosphoramidic dichlorides,  $\text{R}_f\text{CONHPOCl}_2$ , where  $\text{R}_f = \text{CF}_3$  or  $\text{C}_3\text{F}_7$ , were obtained as the final products when  $\text{PCl}_5$  was reacted with  $\text{R}_f\text{CONH}_2$ . The reaction of  $\text{C}_3\text{F}_7\text{CONHPOCl}_2$  with  $\text{H}(\text{CF}_2\text{CF}_2)_3\text{CH}_2\text{OH}$  or with  $\text{N}_2\text{H}_4$  resulted in the cleavage of P-N bond.

Attempted reactions of several fluorocarbon derivatives with  $(\text{PNCI}_2)_3$  were also described.

Microfilm \$2.50; Xerox \$4.80. 91 pages.

## THIAZOLIUM SALTS AS MODELS FOR THIAMINE ACTION

(L. C. Card No. Mic 60-5100)

Edward J. McNelis, Ph.D.  
Columbia University, 1960

Recent evidence for the existence of a thiazolium zwitterion has been coupled to the ability of certain thiazolium salts to catalyze benzoin-type condensations to give a mechanism for thiamine action (1). It is the purpose of this thesis to confirm and extend this proposal which is a modified Lapworth mechanism.



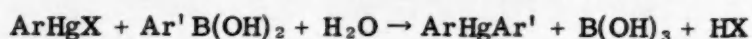


KINETICS OF THE ARYLMERCURATION  
OF ARENEBORONIC ACIDS

(L. C. Card No. Mic 60-4451)

Thomas Charles Muller, Ph.D.  
University of New Hampshire, 1960

The kinetics of the following reaction in aqueous ethanol at 25° have been studied spectrophotometrically:



The objectives were to gain information regarding the mechanism and to test the applicability of linear free energy relationships as substituents in Ar and Ar' were varied. Although the rate increased slightly with increasing water content of the solvent, there was no detectable ionic strength effect.

When phosphate and acetate buffer systems were employed from pH 3.6 to 8, the rate decreased with increasing total buffer concentration at constant pH. If the acid component of the buffer was maintained constant, the reaction velocity did not change with pH. In a carbonate buffer above pH 10 the rate showed no dependence upon buffer concentration but decreased with increasing pH. The results were consistent with the following rate equation:

$$\frac{1}{k_{\text{obs.}}} = A[\text{HX}] + B\left(1 + \frac{K_a}{[\text{H}_3\text{O}^+]}\right)$$

Below pH 8 plots of the reciprocal of the observed rate constant versus molecular acid concentration produced lines with a common intercept. This indicated that the reaction rate was independent of pH at zero buffer concentration in this pH region. The slopes of the lines became greater as the ionization constant of the buffer acid increased.

The ionization constant of benzenboronic acid in "40%" aqueous ethanol at ionic strength 0.15 was determined both spectrophotometrically and potentiometrically. These values were in excellent agreement with each other and with that which was obtained graphically from the rate equation.

The rates of reaction of basic phenylmercuric perchlorate with six substituted benzenboronic acids were determined in "50%" aqueous ethanol. The data were not correlated by the Hammett equation. A much better linear relationship was realized when the following equation was applied:

$$\ln \frac{k}{k_0} = \rho[\sigma + 0.608(\sigma^+ - \sigma)]$$

The value of rho as calculated from this equation was -1.81.

Rate constants for the reaction of phenylmercuric acetate with benzenboronic acid were evaluated over a ten-fold range in acetic acid concentration. Similar runs were carried out with *p*-tolylmercuric acetate upon both benzenboronic acid and *p*-toluenboronic acid. The results were plotted according to the proposed rate equation. The extrapolated rate constants at zero acetic acid concentration agreed well with those obtained by using the arylmercuric hydroxides.

A study was made of the reaction rate of *p*-tolylmercuric hydroxide with several substituted benzenboronic

acids. The rates were correlated by sigma-plus with rho equal to -2.10; however, data from the reaction of *m*-nitromercuric hydroxide with substituted benzenboronic acids produced a correlation with the Hammett equation. The value of rho was identical to that of the *p*-tolylmercurial series.

The results are consistent with a rate-determining attack of arylmercuric ion upon benzenboronate anion. A four-center mechanism involving simultaneous electrophilic attack by mercury upon carbon and nucleophilic attack by oxygen upon boron is also considered. The failure of one set of substituent constants to correlate the data is attributed to varying degrees of resonance stabilization in the transition state for the *para* substituents.

Microfilm \$2.50; Xerox \$8.80. 191 pages.

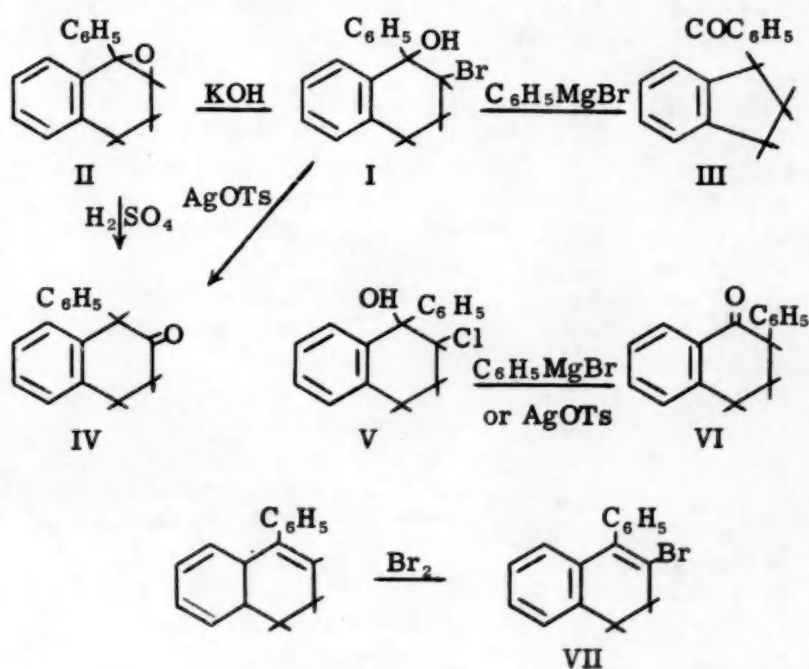
REARRANGEMENT REACTIONS OF  
1,2-DISUBSTITUTED-1-PHENYL-  
3,4-DIHYDRONAPHTHALENES.

(L. C. Card No. Mic 60-5687)

Raymond Alvin Newsom, Ph.D.  
State University of Iowa, 1960

Chairman: Assistant Professor John K. Stille

Trans-2-bromo-1-hydroxy-1-phenyl-1,2,3,4-tetrahydronaphthalene (I) and 1,2-epoxy-1-phenyl-1,2,3,4-tetrahydronaphthalene have been synthesized and their structures have been established. I gave a 38 percent yield of 1-benzoylindan (III) on treatment with phenylmagnesium bromide and a 62 percent yield of 1-phenyl-2-tetralone (IV) on treatment with silver tosylate in acetonitrile. II gave a 54 percent yield of IV when treated with sulfuric acid and traces of IV when treated with sodium hydroxide. Infrared spectra of the crude products indicated that the ketones isolated in each case were the only ones present in the reaction mixtures. The structure of III was established by an independent synthesis from 1-indancarboxylic acid chloride by addition of phenylmagnesium bromide.





Cis-2-chloro-1-hydroxy-1-phenyl-1,2,3,4-tetrahydronaphthalene (V) was found to give a 77 percent yield of 2-phenyl-tetralone (VI) on treatment with phenylmagnesium bromide and a 92 percent yield of VI on treatment with silver tosylate in acetonitrile. This was the only ketone detected in the reaction mixtures.

The preparation of 2-bromo-1-phenyl-3,4-dihydronaphthalene (VII) was accomplished by the addition of bromine to 1-phenyl 3,4-dihydronaphthalene. The structure of this compound was established by oxidation to *o*-benzoylbenzoic acid.

Mechanisms which involve benzonium or phenonium ions are proposed for the rearrangement of I to III and V to VI. A mechanism for the rearrangement of I to IV through the formation of the intermediate II is also proposed. These proposed mechanisms are consistent with the stereochemical requirements for the rearrangements of  $\alpha$ -halohydrins and the products obtained from the rearrangements studied.

Microfilm \$2.50; Xerox \$4.40. 85 pages.

#### DEUTERIUM TRACER STUDIES IN THE ADDITION REACTIONS OF NORBORNENE

(L. C. Card No. Mic 60-5367)

Jack Leland Nyce, Ph.D.  
University of Delaware, 1960

Supervisor: Harold Kwart

The polar and free radical additions of deuterium bromide and the radical addition of deuterio-*p*-thiocresol to norbornene were investigated. A simple bridged ion structure could account for the distribution of deuterium in the polar addition product. The determination was made by a degradation process consisting of dehydrohalogenation and oxidation. The free radical results were accounted for by a classical radical intermediate. During chlorinolysis of the deuterio-*p*-thiocresol adduct of norbornene in acetic acid, a carbonium ion intermediate was formed which gave rise to more rearranged product than was previously observed. The results were in very good agreement with the previous postulate of a nortricyclonium cationic intermediate.

Several attempts were made to determine the stereochemistry of the elimination reaction of hydrogen bromide from norbornyl bromide; the bulky base, the potassium salt of 3-methyl pentanol-3, was used. No quantitative data was obtained, but the major course of the elimination did appear to be *cis*, as predicted.

A reinvestigation of the bromination reaction of norbornene was performed, and a theory was advanced to explain the effect of solvent on the course of the reaction. The compound previously thought to be *exo*-2-*endo*-6-dibromonorbornane was proven to be 2,3-*trans*-dibromonorbornane. The compound obtained by dehydrobromination of the *trans*-dibromide was assigned the structure, 2-bromonorbornene-2. The compound originally thought to be 2-bromonorbornene-2 was shown to be a mixture of several unsaturated bromides.

The bromination of the silver salts of both *exo*- and *endo*-norbornyl carboxylic acids gave *exo*-norbornyl

bromide. The *endo*-bromide was shown to be stable under the conditions of the reaction. By the use of the deuterated acid, it was shown that 50% of the product was a result of rearrangement. From this data a new mechanism for the reaction was postulated.

Microfilm \$2.50; Xerox \$5.20. 103 pages.

#### THE PREPARATION AND PROPERTIES OF POLYTHIOLCARBAMATES

(L. C. Card No. Mic 60-5370)

David Wendell Osborne, Ph.D.  
University of Delaware, 1960

Supervisor: Dr. Elizabeth Dyer

A series of polythiolcarbamates, a little known class of polymers with the repeating unit - CONH - X - NHCOS - Y - S - has been prepared in which X was either aliphatic or aromatic and Y was a wide variety of aliphatic groups. Two methods of synthesis were utilized, the solution polymerization of diisocyanates and dimercaptans in the presence of tertiary amine catalysts, and the interfacial polycondensation of bischlorothiolformates and diamines. The former method gave the better yields, the latter higher molecular weights.

The polythiolcarbamates obtained were extremely insoluble, fairly high melting, odorless, white powders of relatively low molecular weights. They melted somewhat higher than their oxygen analogs, but were less thermally stable.

The thermal degradation of the polythiolcarbamate derived from methylenebis(4-phenyl isocyanate) and 1,6-hexanedithiol was found to yield carbon dioxide, carbonyl sulfide, 6-mercaptohexene, tetrahydro-2-methyl-1-thiapyran, thiopane, 1,6-hexanedithiol, and an intractable, nitrogenous residue. The results of a quantitative study of the degradation indicated that a majority of the thiolcarbamate groups decomposed by splitting into isocyanate and mercaptan moieties, but that a small amount decomposed directly into carbonyl sulfide, amine, and olefin groups.

Microfilm \$2.50; Xerox \$4.20. 80 pages.

#### SOLVOLYSIS AND REARRANGEMENT OF OXYGEN-18 LABELED TRANS- $\alpha,\gamma$ -DIMETHYLALLYL *p*-NITROBENZOATE.

(L. C. Card No. Mic 60-5781)

Melvin Martin Pombo, Ph.D.  
The University of Wisconsin, 1960

Supervisor: Professor Harlan L. Goering

The solvolysis and rearrangement of optically active *trans*- $\alpha,\gamma$ -dimethylallyl *p*-nitrobenzoate I-carbonyl-O<sup>18</sup> in 60% and 90% aqueous acetone have been investigated. In this system the rate of loss of optical activity ( $k_a$ ) exceeds that of formation of solvolysis products ( $k_t$ ); i.e.,  $k_a > k_t$ . In all cases the reactions were complete and first-order.

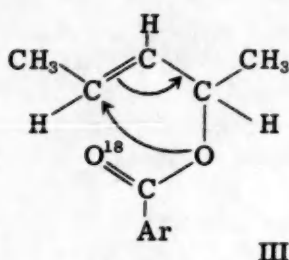
In 90% acetone the ratio,  $k_a/k_t$ , is 5.4; in 60% acetone it is 2.2.

The greater rate of loss of optical activity ( $k_a$ ) than of solvolysis ( $k_t$ ) is interpreted in terms of an internal ion-pair intermediate II which can (a) return to the original allylic compound  $\underline{d}$ -I or its allylic isomer  $\underline{l}$ -I (internal return), or (b) dissociate to the carbonium ion and the accompanying anion. In aqueous acetone, the dissociated cation is completely intercepted by the hydroxylic solvent. The racemization of carbonyl- $O^{18}$  labeled ester I in the presence of either *p*-nitrobenzoic acid or lithium *p*-nitrobenzoate does not result in exchange; i.e., there is no external return. Thus, the rearrangement (racemization) is a simple first-order equilibration,  $\underline{d}$ -ester  $\rightleftharpoons$   $\underline{l}$ -ester. The first order rate constant for racemization ( $k_{rac}$ ) is measured by  $k_a - k_t$ .

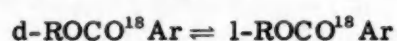
Clearly the relationship between the location of the oxygen atoms in the reactant ( $\underline{d}$ -I) and product ( $\underline{dl}$ -I) is dependent on the nature of the bonding between the anion and cation in the intermediate II. The possibilities for the rearrangement (racemization) of carbonyl- $O^{18}$  labeled  $\underline{d}$ -ester ( $ROCO^{18}C_6H_4NO_2$ ) are outlined in Chart I. The illustrations at the left and the equations at the right show the relative positions of the oxygen atoms in the reactant (one enantiomer) and the product (the other enantiomer) for the rearrangement.

CHART I

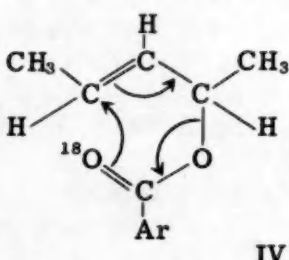
## Case 1



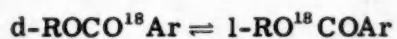
III



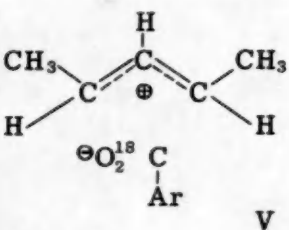
## Case 2



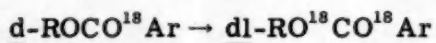
IV



## Case 3



V



Since the rate of equilibration of the oxygen atoms in the unsolvolyzed ester ( $k_{eq}$ ) equals the rate of racemization ( $k_{rac}$ ) in both 60 and 90% aqueous acetone, a process corresponding to Case 1 can be eliminated (this process

would result in racemization but not in equilibration of the oxygen atoms). Isolation of the unsolvolyzed but racemized (rearranged) ester followed by reresolution shows the label to be distributed between the two positions in each enantiomer. In 90% acetone, the rate of  $O^{18}$  equilibration in the two enantiomers is 1/2.9 times that of racemization; in 60% acetone, 1/2.5 times that of racemization. This shows that the reaction has a tendency to follow a course corresponding to Case 2 (IV). However, it is clear that the reaction does not proceed exclusively in this manner for this would require that the enantiomers remain discretely labeled, the  $\underline{d}$ -isomer in the carbonyl position and the  $\underline{l}$ -isomer in the alkyl oxygen position. There is a probability that the oxygen atoms will become scrambled and equivalent during the rearrangement. Scrambling of the oxygen atoms in the enantiomers (Case 3) becomes more important in the more polar 60% aqueous acetone than in 90% acetone.

Microfilm \$2.50; Xerox \$4.80. 94 pages.

## PARACYCLOPHANE STUDIES.

I: [10] PARACYCLOPHANE-12-CARBOXYLIC ACID.

II: 3,3,8,8-TETRAMETHYL

[10] PARACYCLOPHANE.

(L. C. Card No. Mic 60-6492)

Brandes Henry Smith, Ph.D.

Cornell University, 1960

It is possible to group virtually all optically active organic molecules into two broad classes: those whose activity is due to the presence of one or more asymmetric carbon atoms and those which lack the asymmetric atom but whose activity is due to the dissymmetry of the molecule as a whole. It was the aim of this research to investigate certain stereochemical aspects of the paracyclophanes, members of the latter class, in which it is predicted that appropriate *ortho* substituted derivatives will exhibit optical activity due to the dissymmetry created by restricted rotation in the polymethylene bridge.

In the first part of this research [10]paracyclophane-12-carboxylic acid (I) was synthesized and following an unequivocal structure proof the racemate was separated into both pure enantiomorphs by treatment with cinchonidine. Known [10]paracyclophane (II), prepared by standard methods, was chloromethylated to yield 12-chloromethyl [10]paracyclophane (III). This was treated with sodium 2-nitropropanenitronate to give [10]paracyclophane-12-carboxaldehyde (IV) which was oxidized to the acid I with neutral potassium permanganate in acetone. Resolution of the acid was achieved by treating the racemic I with cinchonidine in an acetone solvent and decomposing the salt with hydrochloric acid to give (+)I. The (-)I was obtained by treating the recrystallization and mother-liquor residues with hydrochloric acid and then performing a rapid fractional crystallization. The active acids show an  $[\alpha]_D^{26} 81 \pm 2^\circ$  in chloroform. Prior to this

synthesis various nitration, sulfonation and acylation techniques were attempted but were unsuccessful.

The above resolution studies conclusively show the restricted rotation present in the polymethylene bridge of



these [10]paracyclophanes, a restriction which forces the bridge to locate itself either above or below the plane of the benzene ring.

The second part of this research describes the attempts to prepare 3,3,8,8-tetramethyl [10]paracyclophane (VI). The acyloin precursor, 3,3,8,8-tetramethyl-5-oxo-6-hydroxy [10]paracyclophane (VII) was reduced by the Clemmensen method to 3,3,8,8-tetramethyl-5-oxo [10]paracyclophane (VIII) which could not be further reduced directly to the hydrocarbon. It was possible to reduce the ketone VIII to 3,3,8,8-tetramethyl-5-hydroxy [10]paracyclophane (IX) which also could not be reduced to the hydrocarbon. Various attempts to prepare resolvable derivatives of VIII and IX failed. The acyloin VII was oxidized to 3,3,8,8-tetramethyl-5,6-dioxo [10]paracyclophane (X) by bismuth trioxide and X was reacted with 3,4-diaminobenzoic acid to yield the quinoxaline derivative (XI). A number of halogenation experiments on both X and XI failed to yield a workable compound for resolution studies. It was apparent from the failures observed that increasing steric hindrance was at least partly, if not entirely, the explanation of the difficulties.

Microfilm \$2.50; Xerox \$6.20. 127 pages.

#### THE NITRATION OF INDOLES

(L. C. Card No. Mic 60-5172)

Lowell Richard Smith, Ph.D.  
University of Minnesota, 1960

Adviser: Wayland E. Noland

Nitration of 2-methylindole with sodium nitrate in sulfuric acid at 0° was shown to produce 2-methyl-5-nitroindole (VII, R = H), m.p. 175-176°, in 83% yield, by chromic anhydride oxidation of the 1-acetyl derivative (IX) to 5-nitroacetantranilic acid (X). Acetylation of 2-methyl-5-nitroindole (VII, R = H) with refluxing acetic anhydride in the presence of sodium acetate gave 1-acetyl-2-methyl-5-nitroindole (IX), m.p. 130.5-132°, in 64% yield, and 3-acetyl-2-methyl-5-nitroindole, m.p. 305-306°, in 2% yield. Reactions of 2-methyl-5-nitroindole (VII, R = H) with paraformaldehyde gave 2,2'-dimethyl-5,5'-dinitro-3,3'-methylenebisindole, m.p. 348-354° dec., in 100% yield, and with benzaldehyde gave 3,3'-benzylidene-2,2'-dimethyl-5,5'-dinitrobisindole, m.p. 295-298° dec., in 58% yield. A Mannich reaction of 2-methyl-5-nitroindole (V, R = H) gave 1-dimethylaminomethyl-2-methyl-5-nitroindole, m.p. 173-175°, in 18% yield. 2-Methyl-5-nitroindole (VII, R = H) and 1,2-dimethyl-5-nitroindole (VII, R = CH<sub>3</sub>) were hydrogenated over Raney nickel catalyst at 2 atmospheres of pressure to the corresponding amines, m.p. 157-159° and m.p. 78-79°, in yields of 61% and 37%, respectively. Nitration of 2-methyl-5-nitroindole (VII, R = H) with nitric acid (d. 1.42, here and throughout this abstract) at 100° for 3 minutes gave 3,5-dinitro-2-methylindole (XIII), m.p. 285-287° dec., in 57% yield, as shown by oxidation degradation with chromic anhydride to 5-nitroacetantranilic acid (X). Nitration of 2-methylindole with nitric acid at 50° gave 3,6-dinitro-2-methylindole (XIV), m.p. 305° dec., in 39% yield, as shown by chromic anhydride oxidation to 4-nitroacetantranilic

acid (XV). Nitration of 3,5-dinitro-2-methylindole (XIII) with nitric acid at 100° for 30 minutes gave 2-methyl-3,5,6-trinitroindole (XVI), m.p. 265-267° dec., in 24% yield, which was oxidatively degraded with chromic anhydride to the previously unknown 4,5-dinitroacetantranilic acid (XVII), m.p. 249-250°. A sample of 4,5-dinitroacetantranilic acid (XVII) was prepared independently in 17% yield by permanganate oxidation of the known 4,5-dinitro-N-acetyl-o-toluidine (XVIII). For determination of its ultraviolet and infrared spectra, 2-methyl-3,5,7-trinitroindole was prepared by the method of Robinson (R. Robinson and co-workers, J. Chem. Soc., 1130 (1950)), and was shown to be different from the other trinitroindoles described in the present work. Nitration of 2-methylindole or 3,6-dinitro-2-methylindole (XIV) with nitric acid at 100° for 30 minutes gave 2-methyl-3,4,6-trinitroindole (XIX), m.p. 259-260° dec., in yields of 23% and 45%, respectively. The nitration of ethyl 4-nitro-2-indolecarboxylate (XX) at 100° for 30 minutes gave ethyl 3(?,4)-dinitro-2-indolecarboxylate, m.p. 219-223°, in 95% yield. Acetylation of 5,6-dinitro-o-toluidine and 3,5-dinitro-o-toluidine with refluxing acetic anhydride and sulfuric acid gave the respective N,N-diacetylides, m.p. 122-123° and 123-126°, respectively, the yield being determined in the former case and found to be 38%. The Fischer indole synthesis of acetone m-nitrophenylhydrazones in polyphosphoric acid at 110-115° for 30 minutes gave 2-methyl-4-nitroindole, m.p. 198-199°, and 2-methyl-6-nitroindole, m.p. 107-109.5°, in yields of 8% and 2%, respectively. Nitration of 2-methyl-4-nitroindole and 2-methyl-6-nitroindole in nitric acid at room temperature for 30 minutes gave 3,4-dinitro-2-methylindole (XIVa), m.p. 284-285° dec., and 3,6-dinitro-2-methylindole (XIV), m.p. 305° dec., in yields of 2% and 16% respectively. Nitration of 3-acetyl-2-methylindole with nitric acid in acetic acid at 0° gave 2-methyl-3-nitroindole (XXVI), m.p. 252-253°, 3-acetyl-2-methyl-6-nitroindole (XXVa), m.p. 298-300°, and 3-acetyl-2-methyl-4-nitroindole (XXVb), m.p. 248-249°, in yields of 32%, 27% and 12%, respectively. Nitration of 2-methyl-3-nitroindole (XXVI) with nitric acid at room temperature for 30 minutes gave a mixture of 3,6-dinitro-2-methylindole (XXIV) in 66% yield and 3,4-dinitro-2-methylindole (XXIVa) in 3% yield. Oxidation of 3-acetyl-2-methyl-6-nitroindole (XXVa) with chromic anhydride gave 4-nitroacetantranilic acid (XV); hydrolysis of XXVa with refluxing hydrochloric acid gave 2-methyl-6-nitroindole in 21% yield. Exhaustive nitration of 3-acetyl-2-methyl-4-nitroindole (XXVb) with nitric acid at 100° for 30 minutes gave 2-methyl-3,4,6-trinitroindole (XIX) in 24% yield. Acetylation of 2-methyl-4-nitroindole with refluxing acetic anhydride in the presence of sodium acetate gave 1-acetyl-2-methyl-4-nitroindole, m.p. 111-112°, in 58% yield. Nitration and oxidation of 2-methyl-3-oximinindolenine (XXVII) with nitric acid at 0° gave a mixture of 3,4-dinitro-2-methylindole (XXIVa) and 3,6-dinitro-2-methylindole (XXIV) in yields of 18% and 7%, respectively. Microfilm \$2.50; Xerox \$4.20. 80 pages.





positive identification by comparison with known saturated compounds.

1. Rothschild, M., Ph.D. Thesis, University of Connecticut, 1952.
2. Morey, G. H., U. S. Patent 2,441,669 (1948).  
Microfilm \$2.50; Xerox \$6.40. 132 pages.

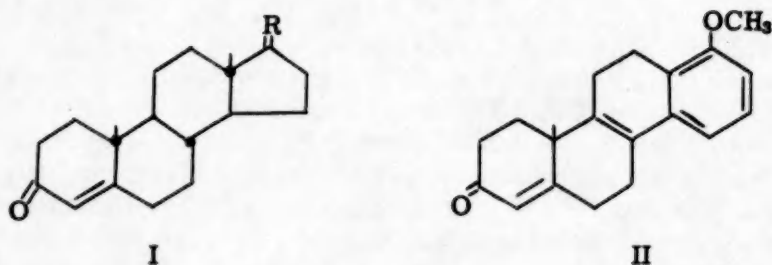
#### FURTHER STUDIES ON THE SYNTHESIS OF TESTOSTERONE

(L. C. Card No. Mic 59-5839)

Walter Anthony Vredenburg, Ph.D.  
The University of Wisconsin, 1959

Supervisor: Professor W. S. Johnson

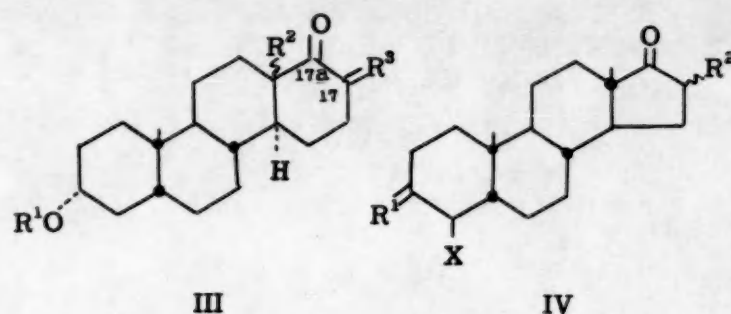
The total synthesis of *d*- and *l*-testosterone I ( $R = \begin{smallmatrix} \text{OH} \\ \text{H} \end{smallmatrix}$ ) has been achieved, using a variation of the hydrochrysene approach reported in the first total synthesis of testosterone published by W. S. Johnson, B. Bannister, R. Pappo and J. E. Pike, *J. Am. Chem. Soc.*, **78**, 6354 (1956). The published synthesis was first repeated in order to obtain more material for the purposes of resolution and physiological testing. It was found that an enzymatic reduction of *dl*-3-ethylenedioxy-5-androsten-17-one led to a mixture of the *d*-17-hydroxy compound and *l*-17-ketone which could be separated by chromatography on alumina. Since the amount of material thus obtained was insufficient for physiological studies, a new synthesis was devised, starting with the readily available tetracyclic ketone II (see W. S. Johnson,



J. Szmuszkovicz, E. R. Rogier, H. I. Hadler and H. Wynberg, *ibid.*, **78**, 6285 (1956). In previous work (see D. G. Martin, Ph.D. Thesis, University of Wisconsin, 1957) the ketone II was converted into the 17-furfurylidene ketone III ( $R^1R^2=H$ ;  $R^3=CHC_4H_3O$ ) by hydrogenation of the  $\Delta^4$ -bond, lithium aluminum hydride reduction of the 3-ketone, metal-in-ammonia reduction of the styrene bond and aromatic nucleus, and basic condensation of the resulting hydroxy ketone III ( $R^1R^2=H$ ;  $R^3=H_2$ ) with furfural. In the present work, a 31% over-all yield of this substance was obtained from the tetracyclic ketone II.

Angular methylation of the tetrahydropyranyl ether of the furfurylidene ketone III ( $R^1=C_5H_5O$ ,  $R^2=H$ ,  $R^3=CHC_4H_3O$ ) followed by acid hydrolysis, produced a mixture of *C/D* *cis* and *trans* isomers III ( $R^1=H$ ,  $R^2=\alpha CH_3$  and  $\beta CH_3$ ,  $R^3=CHC_4H_3O$ ) which was readily separated by chromatography. A 68% yield of the *cis* and a 19% yield of the *trans*-epimer were obtained (ratio 3.7 to 1).

With the 3 $\alpha$ -hydroxyl protected as the acetate, the



*trans*-furfurylidene ketone III ( $R^1=Ac$ ,  $R^2=\beta CH_3$ ,  $R^3=CHC_4H_3O$ ) was ozonized, and the ozonide cleaved with acidic hydrogen peroxide, giving an 87% yield of *dl*-3 $\alpha$ -acetoxyetiohomobilianic acid. Treatment of this diacid with diazomethane gave the dimethyl ester, which was not obtained crystalline, but used directly in the Dieckmann cyclization to give IV ( $R^1=\begin{smallmatrix} \text{H} \\ \text{OAc} \end{smallmatrix}$ ,  $X=H$ ,  $R^2=COOCH_3$ ). The crude  $\beta$ -keto-ester was hydrolyzed, decarboxylated, then treated with alkali to remove any unreacted diester, affording *dl*-3 $\alpha$ -hydroxyetiocholan-17-one IV ( $R^1=\begin{smallmatrix} \text{H} \\ \text{OH} \end{smallmatrix}$ ;  $X=R^2=H$ ) in 53% yield over-all from the bilianic acid. The infrared spectrum of this compound and of an authentic specimen of naturally derived *d*-compound were superimposable. Oxidation of the *dl*-hydroxy ketone with chromium trioxide gave in 97% yield the diketone IV ( $R^1=O$ ;  $X=R^2=H$ ) which was brominated at C-4 with one mole-equivalent of bromine in acidic medium. The crude monobromo product IV ( $R^1=O$ ,  $X=Br$ ,  $R^2=H$ ) was then dehydrobrominated with lithium chloride in dimethylformamide to give *dl*-4-androstene-3,17-dione I ( $R=O$ ) in 55% yield. Infrared spectral comparison with natural substances was made at this and at the diketone IV ( $R^1=O$ ;  $X=R^2=H$ ) stages. Treatment of the *dl*-androstenedione I ( $R=O$ ) with a fermenting yeast medium for two days afforded a mixture from which *d*-testosterone I ( $R=\begin{smallmatrix} \text{OH} \\ \text{H} \end{smallmatrix}$ ) and *l*-androstenedione I ( $R=O$ ) were separated by chromatography. The *l*-androstenedione was converted to *l*-testosterone by reduction with lithium aluminum hydride followed by re-oxidation of the  $\Delta^4$ -3-hydroxy system with manganese dioxide.

Microfilm \$2.50; Xerox \$7.80. 167 pages.

#### FREE RADICAL REACTIONS OF CYCLIC OXIDES AND EPOXIDES IN SOLUTION

(L. C. Card No. Mic 60-5260)

Thomas Joseph Wallace, Ph.D.  
The University of Connecticut, 1960

The mechanism of the *tert*-butyl peroxide-induced addition of 4-, 5-, and 6-membered cyclic oxides and various epoxides to 1-octene has been clarified. Ketones have been identified as products. Thus, the chain transfer atom is the hydrogen atom alpha to the oxygen atom, the intermediate epoxy radicals undergo decyclization to alpha keto radicals, and the intermediate oxide radicals undergo decyclization and subsequent intramolecular hydrogen atom transfer to acyl radicals. The infrared spectra of the products showed a small amount of carbon-carbon

unsaturation was present, indicating chain termination occurs by disproportionation. The products could be identified only by gas chromatography. The products, the authentic compounds, and mixtures of the products and the authentic compounds had identical retention times when chromatographed under the same conditions.

Propylene oxide is of special interest since this epoxide yielded two different products, 2-hendecanone and 5-hydroxy-2-hexanone. The latter compound appears to result from a new type of free radical addition or displacement reaction in which acetyl radicals attack the epoxide ring.

Attempts to dimerize the intermediate free radicals obtained from styrene oxide, propylene oxide, and 1,2-epoxy-3-phenoxy-propane were unsuccessful. These reactions yielded high molecular weight products so further dimerization reactions were not attempted.

A study of the reactivities of the active hydrogen compounds toward *tert*-butoxy radicals was done and these reactivities have been calculated relative to toluene and benzene. The results appear in Table I.

TABLE I  
REACTIVITIES OF  
ACTIVE HYDROGEN COMPOUNDS  
RELATIVE TO TOLUENE AND BENZENE

Reactant	$k_2/k_3^a$	$k_2/k_3$ Relative to Toluene	$k_2/k_3$ Relative to Benzene
Cyclohexane	0.75	1.92	25.0
Benzene	0.032	0.09	1.0
Toluene	0.39	1.00	10.7
Trimethylene oxide	0.045	0.11	1.4
Tetramethylene oxide	0.47	1.21	15.7
Pentamethylene oxide	0.45	1.15	15.0
1,2-Epoxy-3-phenoxy- propane	0.18	0.50	6.0
1,2-Epoxybutane	0.08	0.22	2.7
1,2-Epoxyoctane	0.21	0.58	7.0
4-Methyl-3,4-epoxy- 2-pentanone	0.10	0.28	3.3
Styrene oxide	0.34	0.94	11.3
Ethyleneimine	0.75	1.92	25.0
Propylene oxide	0.035	0.10	1.1

<sup>a</sup>The ratio of the rate of hydrogen atom abstraction to the rate of formation of acetone.

The results indicate that the ease of hydrogen atom abstraction is greatest for the 5-membered ring and decreases in the order  $5 > 6 \gg 4 > 3$ , and that the epoxy radical is similar to a phenyl radical in being highly reactive. The high reactivity of styrene oxide toward *tert*-butoxy radicals is probably due to the stability of the intermediate benzyl type radical. The low reactivity of 4-methyl-3,4-epoxy-2-pentanone would indicate that a carbonyl group does not stabilize an intermediate free radical as well as a phenyl group.

Microfilm \$2.50; Xerox \$4.20. 77 pages.

## SYNTHESIS OF OPTICALLY ACTIVE STEREOREGULAR POLYMERS

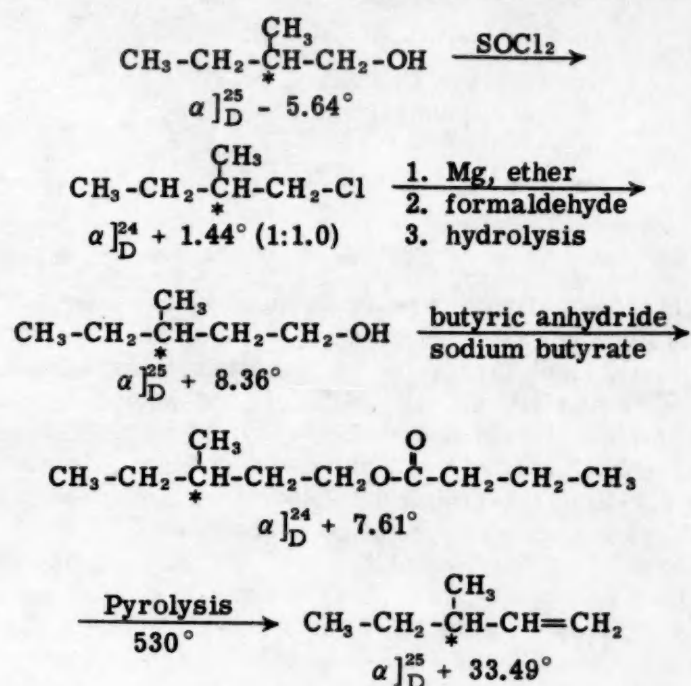
(L. C. Card No. Mic 60-4936)

Edwin Thomas Yates, Jr., Ph.D.  
University of Maryland, 1959

Supervisor: Professor William J. Bailey

Much work has been done recently on the polymerization of alpha-olefins by use of heterogeneous anionic catalysis. Such polymerization results in three main types of polymer; isotactic, syndiotactic, and atactic. In order to elucidate more completely the nature of an isotactic polymer and to determine the effect of asymmetry on the properties, the synthesis of an isotactic polymer from an optically active olefin was undertaken.

Since it was felt that the greatest effect on the properties of the polymer would result if the asymmetric center was immediately adjacent to the polymer chain, the simplest possible optically active olefin, 3-methylpentene-1, was synthesized from 96% pure *d*-amyl alcohol:



Polymerization of this alpha-olefin by use of a Ziegler-type catalyst resulted in a polymer which was separated into a xylene-soluble fraction ( $\alpha]_{\text{D}}^{23} + 94.9^\circ$ ) and another fraction (m.p. 271-278°) which was soluble in boiling 1,1-ditolylethane. Though mostly insoluble in 1,1-ditolylethane at room temperature, a small portion of this insoluble fraction remained in solution and showed a specific rotation ( $\alpha]_{\text{D}} -257.2^\circ$ ) which was opposite in direction of rotation from that of the monomer and of the xylene-soluble fraction of polymer. The fractions of polymer with optical rotations in opposite directions must be diastereoisomers. Because of its solubility properties the exact nature of the fraction soluble only in boiling 1,1-ditolylethane was not determined.

Polymerization of *d*,1-3-methylpentene-1 by Ziegler-type catalysis yielded a polymer which was separated into cold benzene-soluble, cold xylene-soluble, hot *p*-cymene-soluble and refluxing 1,1-diphenylethane-soluble fractions. The last mentioned fraction had a melting point of 229-237°.



Copolymerization of a mixture of approximately 60% d-3-methylpentene-1 and 40% 4-methylpentene-1 by use of Ziegler-type catalysis resulted in a copolymer which was completely benzene-soluble and which had a specific rotation of  $[\alpha]_D^{25} + 112.4^\circ$ . The infrared spectrum on a film of this copolymer confirmed the presence of isopropyl groups derived from the 4-methylpentene-1 moiety in the polymer.

In addition to the study of stereoregular polymers, a further study was made of the pyrolysis of dimethyl  $\alpha, \alpha'$ -dimethyldiacetyltartrate to 2,3-dicarbomethoxy-1,3-butadiene. Hydrolysis of 2,3-dicarbomethoxy-1,3-butadiene with dilute sodium hydroxide resulted in a low yield of 2,3-dicarboxy-1,3-butadiene.

Microfilm \$2.50; Xerox \$4.40. 82 pages.

#### PART A. THE PREPARATION AND THERMAL REARRANGEMENT OF BENZYL AMINIMIDES.

#### PART B. THE PREPARATION OF AN OPTICALLY ACTIVE AMINIMIDE.

(L. C. Card No. Mic 60-5706)

Ernest L. Yeakey, Ph.D.  
State University of Iowa, 1960

Chairman: Professor Stanley Wawzonek

#### PART A

The preparation and rearrangement of two benzyl-aminimides has been successfully carried out from 1,1-dimethyl-2-acetylhydrazine. The hydrazone chlorides were obtained by treating 1,1-dimethyl-2-acetylhydrazine with benzyl chloride and p-nitrobenzyl bromide respectively. Treatment of these salts with sodium hydroxide gave 1,1-dimethyl-1-benzylamine-2-acetamide and 1,1-dimethyl-1-p-nitrobenzylamine-2-acetamide.

Distillation of 1,1-dimethyl-1-benzylamine-2-acetamide and 1,1-dimethyl-1-p-nitrobenzylamine-2-acetamide under reduced pressure gave 1,1-dimethyl-2-benzyl-2-acetylhydrazine and 1,1-dimethyl-2-p-nitrobenzyl-2-acetylhydrazine. The latter compound upon reduction with platinum and hydrogen followed by acetylation with acetic anhydride gave 1,1-dimethyl-2-p-acetaminobenzyl-2-acetylhydrazine which was also prepared by the reduction and acetylation of the dimethylhydrazone of p-nitrobenzaldehyde.

The structure of 1,1-dimethyl-1-p-nitrobenzylamine-2-acetamide was demonstrated by the formation of 1,1-dimethyl-1-p-nitrobenzylhydrazonium chloride upon hydrolysis with hydrochloric acid. Treatment of 1,1-dimethyl-1-p-nitrobenzylhydrazonium chloride with benzaldehyde gave 1,1-dimethyl-1-p-nitrobenzyl-2-benzylidenhydrazonium chloride which was also prepared from p-nitrobenzyl chloride and the dimethylhydrazone of benzaldehyde.

An attempt to convert 1,1-dimethyl-1-p-nitrobenzylhydrazonium chloride into 1,1-dimethyl-1-p-nitrobenzylaminimide by treatment of the hydrazone chloride with sodium methoxide caused decomposition and the formation of form-aldehyde, ammonia, and dimethyl-p-nitrobenzylamine.

Alkylation of 1,1-dimethyl-1-p-nitrobenzylamine-2-

acetamide with methyl iodide gave 1,1-dimethyl-1-p-nitrobenzyl-2- $\alpha$ -methoxyethylidenhydrazonium iodide which indicated the presence of an enolate anion resonance form. Infrared spectral data confirmed that this was a major resonance form.

Reduction of 1,1-dimethyl-1-p-nitrobenzylamine-2-acetamide with tin and hydrochloric acid caused hydrogenolysis of the nitrogen-benzyl bond and hydrolysis of the acetyl group and gave unsymmetrical dimethylhydrazine.

#### PART B

An aminimide, 1,1,1-methylethyl-p-nitrobenzylamine-2-acetamide, which contains an asymmetric nitrogen atom has been prepared. Alkylation of 1,1-methylethyl-2-acetylhydrazine with p-nitrobenzyl bromide gave dl-1,1,1-methylethyl-p-nitrobenzyl-2-acetylhydrazonium bromide which was dehydrobrominated with sodium hydroxide to dl-1,1,1-methylethyl-p-nitrobenzylamine-2-acetamide. The structure of the aminimide was indicated by the similarity of its infrared spectra to that of 1,1-dimethyl-1-p-nitrobenzylamine-2-acetamide.

Resolution of the aminimide was attempted by the classical method of fractional crystallization of the diastereoisomeric salts formed with an optically active acid. The salts obtained with d-tartaric, d- $\beta$ -camphorsulfonic, and d- $\alpha$ -bromo- $\pi$ -camphorsulfonic acids were gums, however, and have not been crystallized successfully at this time.

Microfilm \$2.50; Xerox \$3.80. 66 pages.

#### CYCLIC ORGANOSILICON AND RELATED COMPOUNDS

(L. C. Card No. Mic 60-4913)

Ernest Adolph Zuech, Ph.D.  
Iowa State University of Science and Technology, 1960

Supervisor: Henry Gilman

5,10-Dihydrophenazasiline compounds have been prepared by new procedures, which involve reactions of 2,2'-dilithiodiarylamines with appropriately substituted silicon halides and hydrides. Thus, by varying either one or both of the reactants a wide variety of interesting compounds has been prepared. For example, 5-ethyl-10,10-diphenyl-5,10-dihydrophenazasiline and 5,5'-diethyl-10,10'-spirobi-(5,10-dihydrophenazasiline) were obtained by treating one and two molar equivalents of N-ethyl-2,2'-dilithiodiphenylamine, respectively, with dichlorodiphenylsilane and with silicon tetrachloride.

Bromination studies have been conducted on 5-ethyl-10,10-diphenyl-5,10-dihydrophenazasiline and on certain diarylamines. The latter work was performed in an effort to obtain 2,2'-dibromodiarylamines suitable for the preparation of 5,10-dihydrophenazasiline compounds. Of special interest is the bromination of N-methyldi-p-tolylamine to give a good yield of the 2,2'-dibromo derivative. This material was converted to the dilithium intermediate by halogen-metal interconversion with n-butyllithium

and subsequently to 2,5,8-trimethyl-5,10-dihydrophenazasiline compounds by treatment with the appropriate silicon halides.

The 5,5,10,10-tetraphenyl and 5,5,10,10-tetrabenzyl derivatives of 5,10-dihydrosilanthrene have been prepared by reacting *o*-phenylenedilithium with dichlorodiphenylsilane and with dibenzylchlorosilane. These derivatives are the first members of a new cyclic organosilicon system, the silicon analog of 9,10-dihydroanthracene. Treatment of *o*-phenylenedilithium with diphenylsilane afforded *o*-phenylenebis(diphenylsilane), together with other compounds.

Several new non-cyclic organosilicon compounds were synthesized which incorporated aralkyl groups in combinations with polyphenyl groups. These were prepared in order to obtain low-melting organosilicon compounds suitable for applications as high temperature lubricants.

Reactions of some 2-triphenylsilyl ethyl derivatives were investigated. Of particular noteworthiness was the reaction of 2-chloroethyltriphenylsilane with magnesium in tetrahydrofuran to give a good yield of 2-triphenylsilyl ethylmagnesium chloride, which apparently is the first preparation of such a Grignard reagent.

Microfilm \$2.50; Xerox \$7.40. 157 pages.

#### CHEMISTRY, PHARMACEUTICAL

##### A STUDY OF INVERSE ISOTOPE DILUTION ANALYSES OF CHLORTETRACYCLINE

(L. C. Card No. Mic 60-6096)

Charles Edward Breckinridge, Jr., Ph.D.  
Purdue University, 1960

Major Professor: Dr. John E. Christian

Chlortetracycline was quaternized using carbon-14-labeled methyl iodide of known specific activity. The resulting radioactive chlortetracycline methiodide was diluted by the addition of a known amount of non-radioactive chlortetracycline methiodide. The specific activity of a purified portion of the mixture was then determined. From these data, the quantity of chlortetracycline originally present was calculated.

Purification of the compound was effected through the use of paper chromatography. Both ascending and descending methods were studied and found to yield similar results. Butanol saturated with water was used as the solvent.

Following elution of the developed chromatogram, the specific activity of the purified chlortetracycline methiodide was determined by a combination of ultraviolet spectrophotometric and liquid scintillation counting techniques.

The developed procedure was applied to the determination of chlortetracycline in blood with satisfactory results.

Microfilm \$2.50; Xerox \$4.80. 92 pages.

##### NATURE OF A BACTERIAL VITAMIN B<sub>12</sub> ANTAGONIST

(L. C. Card No. Mic 60-5306)

Zdzislaw Felix Chmielewicz, Ph.D.  
University of Illinois,  
Chicago Professional Colleges, 1960

From five separate cultures of *Lactobacillus leichmannii* 313, grown in media containing sufficient amounts of all necessary nutrients, there was isolated a microbiologically active material. Although these five preparations varied in potency, they all inhibited the growth of the above-mentioned organism by interfering with the deoxyribonucleic acid synthesis specifically as vitamin B<sub>12</sub> antagonists.

Studies on the chemical composition have shown that all five preparations are ribonucleoproteins and that they contain seventeen identifiable amino acids, phosphorus, ribose, the purines (adenine and guanine), and the pyrimidines (cytosine and uracil).

All constituents present have been quantitatively determined. The amino acid content of an acid hydrolyzed sample was determined by a paper chromatographic technique. The total phosphorus content was determined by a colorimetric procedure, and purine and pyrimidine phosphorus was determined on an acid hydrolyzed sample and separated by a selective silver salt precipitation. The purine-bound carbohydrate content was determined by a colorimetric procedure after first establishing by three separate paper chromatographic procedures that ribose was the sole carbohydrate present.

The purines and pyrimidines present were determined by analysis of one basic and two acid hydrolysates of the material. The first acid hydrolysate, although useful for the determination of purine- and pyrimidine-bound phosphorus, was found to be unsuitable for the quantitative determination of the purine bases and pyrimidine nucleotides since no effort was made to separate the other possible degradation products which may have arisen from this hydrolysis.

A more drastic hydrolysis with 12 N perchloric acid, followed by paper chromatography and elution of the four ultraviolet-absorbing spots, was successfully used for the quantitative determination of the purines (adenine and guanine) and the pyrimidines (cytosine and uracil) by the differential extinction technique. These results were confirmed by subjecting an identical hydrolysate of one of the five preparations to an ion-exchange chromatographic separation using the "gradient elution technique" and ultraviolet spectral analysis of each of the 120 constant-volume fractions collected. The basic hydrolysate, after separation by ion-exchange chromatography and gradient elution, qualitatively confirmed the presence of the above-mentioned purines and pyrimidines.

The amino acids, either total amount present or the amount of any of the seventeen identifiable amino acids, could not be correlated with microbiological activity. Neither could a relationship between activity and the purine and pyrimidine base content be established. In all preparations the molar ratios of adenine and cytosine to guanine and uracil approached 1.0.

Although the per cent of phosphorus does not correlate with microbiological activity, it was found that the ratio of total phosphorus to total moles of purine and pyrimidine



was proportional to microbiological activity. In addition, it was concluded that the higher the ratio of pyrimidine phosphorus to moles of pyrimidine, the more active the preparation.

Utilizing the fractional electrical transport technique, the homogeneity of one of the samples was established. This was confirmed by the presence of a single peak in the ultracentrifuge pattern of the same sample.

Microfilm \$2.50; Xerox \$3.80. 68 pages.

#### THE SYNTHESIS OF HOMOLOGUES OF SALICYLIC ACID

(L. C. Card No. Mic 60-5243)

Joseph Ellis Moody, Jr., Ph.D.  
The University of Connecticut, 1960

Seven 2,5-dialkyl substituted phenols, 2 of which were obtained commercially and 5 of which were synthesized by a modified Friedel-Crafts reaction were carboxylated by the Kolbe-Schmitt reaction to form homologues of salicylic acid.

The pharmacological study of ortho-thymotic acid, in showing it to be a more active analgesic than sodium salicylate, provided the incentive to prepare other compounds in this series. The acids prepared are as follows: 2,5-dimethylsalicylic acid, 2-methyl-5-ethylsalicylic acid, 2-methyl-5-sec-butylsalicylic acid, 2-methyl-5-tert-butylsalicylic acid, 2-methyl-5-sec-amylsalicylic acid, 2-methyl-5-tert-amylsalicylic acid, and 2-methyl-5-[2-(3-methylbutyl)]-salicylic acid.

The acids are identified both by their method of synthesis and by their neutralization equivalents. They could not be esterified by direct condensation because of steric hindrance. Instead, their methyl esters had to be formed through the silver salts of the acids by reaction with methyl iodide. The 3-nitro and the 3-bromo derivatives of the acids were prepared and analyzed for future reference and identification. The preparation of the amides of 2 of the acids was attempted, but these reactions produced anhydro compounds.

Microfilm \$2.50; Xerox \$3.00. 44 pages.

#### DIENE SYNTHESIS OF BICYCLIC ANALOGS OF TETRACYCLINE

(L. C. Card No. Mic 60-5314)

Masumi Nakamichi, Ph.D.  
University of Illinois,  
Chicago Professional Colleges, 1960

As a part of the study of the synthesis of analogs of the tetracycline molecule, the Diels-Alder reaction has been investigated. p-Toluquinol has been allowed to react with a series of symmetrical and unsymmetrical dienes. The following dienes were used:

1. 1,3-Butadiene.
2. 1-Methoxy-1,3-butadiene.

3. 2-Methyl-1,3-butadiene (Isoprene).

4. 2,3-Dimethyl-1,3-butadiene.

5. 1,3-Pentadiene (Piperylene).

6. Cyclopentadiene.

7. Cyclohexadiene.

Structures for the Diels-Alder adducts have been proposed. Chloroprene was used as a diene but no definite product could be identified. Attempts to condense p-toluquinol with anthracene were unsuccessful. Attempts to utilize 4,4-dimethyl-1-keto-1,4-dihydronaphthalene, 4-methyl-4-dichloromethyl-2,5-cyclohexadien-1-one, and 4-methyl-4-trichloromethyl-2,5-cyclohexadien-1-one as the dienophile in a Diels-Alder reaction were also unsuccessful.

Preliminary antibacterial screening has also been carried out on these products and certain of them have shown marked *in vitro* activity. These were the adducts of p-toluquinol with isoprene and cyclohexadiene.

Microfilm \$2.50; Xerox \$5.60. 114 pages.

#### THE ANALYSIS OF MANILA ELEMI OIL

(L. C. Card No. Mic 60-5257)

Angelo Francis Summa, Ph.D.  
The University of Connecticut, 1960

The analysis of Manila elemi oil by both fractional distillation and gas chromatography is described.

d- $\alpha$ -Phellandrene, elemol and elemicin were isolated and identified by a variety of derivatives.

Elemol, on treatment with selenium, was converted to a mixture of hydrocarbons from which eudalene, cadalene, vetivazulene and guaiazulene were isolated. Cadalene and guaiazulene are here reported for the first time as degradation products of elemol. Infrared and ultraviolet absorption spectra of these compounds are included.

The oil of cohobation was examined and from it, d- $\alpha$ -terpineol and d-carvone were isolated. This constitutes the first report of the occurrence of these compounds in elemi oleoresin.

The preparation of two new derivatives for isoelemicin is described, namely, isoelemicin picrate and the maleic anhydride adduct of isoelemicin.

The infrared absorption spectrum of elemi oil is also reported. Microfilm \$2.50; Xerox \$3.60. 62 pages.

#### A POLAROGRAPHIC STUDY OF SEVERAL CANCER CHEMOTHERAPEUTIC AGENTS

(L. C. Card No. Mic 60-6140)

Harold Zallen, Ph.D.  
Purdue University, 1960

Major Professors: John E. Christian and  
Adelbert M. Knevel

Bis-2-chloroethylamine type compounds (Nitrogen Mustards) have enjoyed a certain amount of success as

chemotherapeutic agents in the treatment of cancer. The anticarcinogenic activity of these compounds has been postulated to result from the cyclization of the parent nitrogen mustard to form the highly reactive ethylenimonium (EI) cation. A polarographic technique has been used to study the presence and the rate of formation of the EI ion in buffered aqueous solutions.

Specific rate constants have been determined for the rate of cyclization of the ethylenimonium ion of 2,2'-dichlorodiethylamine hydrochloride ( $0.0035 \text{ min.}^{-1}$ ); N,N-Bis(2-chloroethyl)glycine hydrochloride ( $0.583 \text{ min.}^{-1}$ ); 5-Chloro-1-(chloromethyl-n-pentyl)-2-chloroethylamine hydrochloride ( $0.0095 \text{ min.}^{-1}$ ); 2,2'-Dichloro-N-methyl diethylamine, N-oxide hydrochloride (Nitromin)  $0.188 \text{ min.}^{-1}$ ; 5-Bis(2-chloroethyl)aminomethyl-4-(methoxymethyl)-2-methyl-3-pyridinol dihydrochloride ( $0.233 \text{ min.}^{-1}$ ). Each compound revealed that first-order kinetics ensued when measured in borate buffer solution at a pH of 7.36 at  $25^\circ\text{C} \pm 0.01^\circ\text{C}$ .

Evidence of the presence of the ethylenimonium ion was established by two means. The first was quantitative polarographic measurement (anodically) by use of a thiosulfate ion index. The second method was evidenced by the diffusion current reaching a constant plateau (cathodically) with time, the formation being followed polarographically.

A preliminary polarographic study of the cyclic ethanol amido ester of bis(2-chloroethyl)-phosphamide (Cytosan) was not found polarographically reducible at the dropping mercury electrode and the investigation did not reveal the presence of ethylenimonium ion formation.

Nitromin was reduced at the dropping mercury electrode and a one electron reduction to the active form Methyl bis(2-chloroethyl)amine has been postulated.

No exact correlation can be postulated for the compounds investigated between the specific rate constant and their biological activity. This fact is primarily due to the lack of standardized biological data, thus suitable correlation could not be realized.

A new polarographic cell, called the Zallen Cell, containing a thermostat has been developed. The cell was found to be suitable for both kinetic studies as well as regular polarographic procedures.

Microfilm \$2.50; Xerox \$7.80. 167 pages.

## CHEMISTRY, PHYSICAL

### A STUDY OF RUTHENIUM(III) AND RUTHENIUM(IV) SPECIES IN AQUEOUS SOLUTIONS

(L. C. Card No. Mic 60-6093)

Donald Keith Atwood, Ph.D.  
Purdue University, 1960

Major Professor: Professor Thomas De Vries

A study of various species of Ru(III) and Ru(IV) and the equilibria between them has been made in an attempt to clarify various anomalies existing in the present literature

on these subjects. Various methods and experimental techniques have been used in approaching the problems involved and a number of interesting results obtained.

### I. Ion Exchange Preparation of Ru(III)

An attempt has been made to obtain a pure uncomplexed  $\text{Ru}^{+3}$  species in perchloric acid by ion exchange methods developed by previous workers. Although these attempts failed, a pure Ru(III) species was obtained and the spectrum agrees with that reported by previous authors.

### II. The Spectra of Ru(IV) on Ion Exchange Resins

A technique has been developed which enabled the determination of the spectra of Ru(IV) species on ion exchange supports. The investigation has shown that equilibration of Ru(IV) solutions with ion exchange resins causes dissociation of Ru(IV) polymer into  $\text{RuO}^{++}$  monomer.

### III. Effect of Various Reducing Agents on Ru(IV)

A study of the effect of various reducing agents on Ru(IV) has been made. Results indicate the existence of a stable species with an apparent oxidation state of 3.5. Studies on the effect of  $\text{VO}^{++}$ , silver, mercury,  $\text{Fe}^{+2}$ , copper and Sn(II) as well as titration of Ru(IV) with  $\text{V}^{++}$  have enabled estimation of the potentials involved in reduction of Ru(IV) to Ru(3.5) and, finally, to Ru(III).

### IV. Polarography of Ru(III) and Ru(IV)

Polarographic studies of Ru(III) and Ru(IV) aqueous solutions have been made. Diffusion current data, spectral correlations, and comparison of the Ru(III) and Ru(IV) polarograms have enabled characterization of the reduction and oxidation waves observed. Results indicate that Ru(IV) is reduced through a Ru(3.5) intermediate to Ru(III) and finally to Ru(II). Half wave potentials obtained agree with the potentials estimated from the study on reducing agents, thus making it possible to draw a potential diagram for the lower oxidation states of ruthenium. A study of the dependence of the half wave potentials on pH was also made and a mechanism for the polarographic reduction of Ru(IV) to Ru(III) proposed.

Investigations of the Ru(IV)-acetonitrile system and coulometric determination of polarographic-n values are also reported.

Microfilm \$3.00; Xerox \$10.35. 229 pages.

### A STUDY OF THE KINETICS OF THE OXIDATION OF URANIUM(IV) BY CERIUM(IV)

(L. C. Card No. Mic 60-4937)

Floyd Beatty Baker, Ph.D.  
The University of New Mexico, 1960

The kinetics of the oxidation of uranium(IV) to uranium(VI) by cerium(IV) was studied in perchloric acid-sodium perchlorate solutions at ionic strength two. The

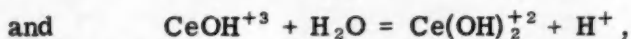


hydrolysis of cerium(IV) was also studied in the aforementioned media.

In the kinetic study the rate of reaction was followed spectrophotometrically utilizing the absorption peak of cerium(IV) at 2900Å. A recording Model 14 Cary spectrophotometer was used. The rate of oxidation was investigated from 2.4°C to 15.6°C in the perchloric acid concentration range from 0.800 to 2.00 molar; the initial cerium(IV) and uranium(IV) concentrations ranged from 4.2 to 6.0 x 10<sup>-5</sup> molar and 2.6 to 8.8 x 10<sup>-5</sup> molar, respectively.

The hydrolysis of cerium(IV) was studied potentiometrically by measurement of the potential of the cerium(III)-cerium(IV) couple as a function of perchloric acid concentration. Total cerium concentration was 3.51 x 10<sup>-3</sup> molar; the cerium(III)-cerium(IV) ratio was varied by addition of hydrogen peroxide. The potential measurements were made at 25.0°C and 1.6°C in the perchloric acid concentration range from 0.300 to 2.00 molar.

Results of the potentiometric measurements suggest that the hydrolysis of cerium(IV) can be represented by the equations

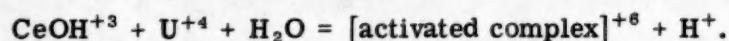


where the first hydrolysis step is at least 85 percent complete at 25.0°C, and is at least 70 percent complete but not more than 90 percent complete at 1.6°C. Values for the second hydrolysis quotient  $K_2$  were found to be 0.15 ± 0.05 and 0.08 ± 0.04 at 25.0°C and 1.6°C respectively. Considering the relatively small value of  $K_2$  at both temperatures it is concluded that the predominant species in 2 molar perchloric acid is  $\text{CeOH}^{+3}$ .

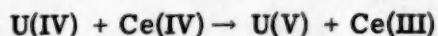
The following rate law written in terms of the predominant species in solution is proposed on the basis of kinetic data obtained.

$$-d[\text{Ce(IV)}]/dt = 2k[\text{U}^{+4}][\text{CeOH}^{+3}]/[\text{H}^+].$$

This rate law for the rate determining reaction shows that the formation of the activated complex from the principal species in solution can be represented by the net process



This rate determining reaction is probably



followed by the fast reaction



The constants log A and  $E_a$  in the Arrhenius equation were obtained by a method of least squares and are 14.6588 and 14.6 kcal/mole respectively. Values of the entropy, heat, and free energy of activation were calculated for the net activation process and are  $\Delta S^\ddagger = 6.2 \pm 2.5$  e.v.,  $\Delta H^\ddagger = 14.0 \pm 0.7$  kcal/mole, and  $\Delta F^\ddagger = 12.2 \pm 0.2$  kcal/mole. These values pertain to the reaction in 2.00 molar perchloric acid at 2.4°C.

Microfilm \$2.50; Xerox \$5.60. 112 pages.

## INTERACTIONS OF THE LANTHANIDES WITH ETHYLENEDIAMINETETRAACETIC ACID

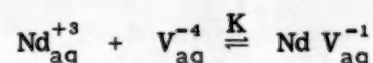
(L. C. Card No. Mic 60-4713)

Francis Frederick Carini, Ph.D.  
Clark University, 1960

Supervisor: Arthur E. Martell

The interaction of ethylenediaminetetraacetic acid and some members of the rare earth metal series were investigated. The equilibria established between the chelating agent,  $\text{V}^{-4}$ , the rare earth metal ions,  $\text{R}^{+3}$ , and the chelated metal ions,  $\text{RV}^{-1}$ , were determined by measuring the optical absorption at selected wave lengths.

The equilibria of the reaction between neodymium and the ethylenediaminetetraacetate ion were determined at 7.5°C and 30°C and were determined at various values of ionic strength. The values of the stability constant for the reaction



in which

$$K = \frac{C_{\text{NdV}}^{-1}}{C_{\text{Nd}}^{+3} \times C_{\text{V}}^{-4}}$$

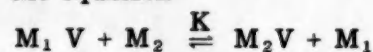
are given in Table I.

Table I

Nd - EDTA Equilibria Constants

$\mu$	Log $K_{30^\circ}$	Log $K_{7.5^\circ}$
0.0166	18.3	18.7
0.283	18.0	18.4
0.0366	18.0	18.4
0.0418	17.7	18.1

The relative stability constants of lanthanum, cerium, praseodymium, neodymium and samarium chelates were investigated at 7.5° and 30°C also. The reactions may be represented by the equation



in which

$$K = \frac{C_{\text{R}_2 \text{V}}}{C_{\text{R}_1 \text{V}}} \times \frac{C_{\text{R}_1}}{C_{\text{R}_2}}$$

The thermodynamic quantities  $\Delta F^\circ$ ,  $\Delta H^\circ$  and  $\Delta S^\circ$  associated with the chelation of rare earth metals by ethylenediaminetetraacetic acid were calculated using the measured stability constants. The results of these calculations for the free energy change, enthalpy changes and entropy changes are given in Table II.

The free energy changes are large and negative, which indicate that the reaction occurs spontaneously. The free energy changes determined in this investigation are the highest ever reported for these rare earths.

The enthalpy changes are small compared to the free energy changes. The enthalpy of chelation is quite similar in magnitude to the enthalpy of hydration of gaseous ions.

Table II  
Thermodynamic Quantities Associated with  
The Interaction of Rare Earths with  
EDTA

Metal	$-\Delta F^\circ$ Kcal		$-\Delta H^\circ$ Kcal	$\Delta S^\circ$ (eu)
	30 °C	7.5 °C		
La	22.6	21.7	4	6(10) <sup>1</sup>
Ce	23.8	22.8	4	6(10) <sup>1</sup>
Pr	24.9	23.3	5	6(10) <sup>1</sup>
Nd	25.9	24.5	7	6(10) <sup>1</sup>
Sm	26.5	24.6	8	6(10) <sup>1</sup>

The most striking factor is the large positive entropy change which is associated with the reaction. Such entropy changes are characteristic of metal-chelate systems.

Microfilm \$2.50; Xerox \$4.00. 72 pages.

THE EFFECTS OF AQUEOUS ELECTROLYTES  
ON THE ACTIVITY COEFFICIENT OF  
TERTIARY BUTYL CHLORIDE AND ITS  
SOLVOLYSIS TRANSITION STATE

(L. C. Card No. Mic 60-5421)

George Alton Clarke, Ph.D.  
The Pennsylvania State University, 1960

An extensive investigation of aqueous electrolyte effects on the activity coefficients of the ground and solvolysis transition states of tertiary butyl chloride has been made in order to critically evaluate the ion-atmosphere model for electrolyte effects on dipoles as postulated by Bateman, Church, Hughes, Ingold and Taher. Previous investigators have generally indicated the failure of this simple electrostatic model to describe kinetic salt effects on unimolecular processes in mixed media. By measuring the rate of pressure drop of gaseous tertiary butyl chloride over an aqueous solution in a closed system, both the distribution (h) and rate constants ( $k_p$ ) for the solution process and the solvolysis of gaseous tertiary butyl chloride have been determined.

Electrolytes are observed to salt-out the ground state and to have variable salting-in and salting-out effects on the transition state. The effects are specific to the electrolyte. The transition state exhibits an independence of the cation of an electrolyte; the ground state behaves similarly, excepting that it exhibits a definite cation effect with large electrolyte cations. The results do not parallel the nucleophilic order of the anions of the electrolytes, but instead they parallel both the partial molal entropies and the relative molar proton NMR chemical shifts of the anions of the electrolytes. The observed effects on the activity coefficients of the tertiary butyl chloride systems are accountable, not only in terms of solute dipole-ion electrostatic interactions, but also from contributions arising from solvent-ion (medium effects) electrostatic interactions and short-range dispersion force interactions.

The medium effects do not appear to be very sensitive to the charge distribution of the solute molecule. The nature of the parallelism between the salt effects for inorganic electrolytes on the tertiary butyl chloride system and those found with significantly different non-electrolytes also suggests an insensitivity of medium effects to the non-electrolyte. The rate constant for the gaseous solvolysis of tertiary butyl chloride in  $D_2O$ , compared to  $H_2O$ , indicates, however, a sensitivity of the transition state to hydrogen bonding; ground state hydrogen bonding does not appear to be of very great importance.

The electrolyte effects on the conventional rate constant ( $k_c$ ) for tertiary butyl chloride have been determined from the separate effects observed on the ground and transition states. It is found that electrolytes accelerate the rate of solvolysis of the dissolved tertiary butyl chloride at unit concentration and that the effects are approximately constant for each charge type. If the contribution of the activity of water is neglected then the results for many 1-1 and 1-2 electrolytes agree, almost quantitatively, with the ion-atmosphere theory. These results, in terms of the ion-atmosphere equation, reflect a high concentration of charge on the center carbon and chlorine atoms in the transition state ( $\sim 0.8$  electronic charges).

The fraction of olefin formed in the solvolysis reaction appears to roughly parallel the salt effects observed on the ground and transition states of tertiary butyl chloride.

Microfilm \$2.50; Xerox \$5.60. 114 pages.

HEAT CAPACITY AND  
MAGNETIC SUSCEPTIBILITY OF  
THULIUM ETHYLSULFATE

(L. C. Card No. Mic 60-5879)

Bernard Clemence Gerstein, Ph.D.  
Iowa State University of Science and Technology, 1960

Supervisor: Frank H. Spedding

The heat capacity and parallel and perpendicular magnetic susceptibilities of thulium ethylsulfate have been measured in the range 15-300°K and 1.3-200°K respectively. The heat capacity measurements were made with a standard adiabatic calorimeter, and the susceptibilities were obtained using a dynamic mutual inductance technique. A description of the apparatus and experimental technique used in making the susceptibility measurements has been given.

The contribution of the 4f electrons to the heat capacity has been evaluated by measuring the heat capacity of lutetium ethylsulfate in the range 15-300°K, and assuming that a small constant difference exists between the lattice heat capacities of the Tm and Lu salts in the range 15-200°K.

The contribution of the 4f electrons to the heat capacity and perpendicular and parallel susceptibilities has been calculated. The calculation involved the angular part of the crystal field matrix elements calculated by Elliot (1), Stevens (2), and Elliot and Stevens (3), (4), and two sets of crystal field parameters. The first set was extrapolated from the work of Elliot and Stevens (5), and the second was obtained from Gruber and Conway (6). The first set of





a Springer-Ostwald pycnometer or a Robertson pycnometer permitting accurate measurements of volatile liquids. Refractive index measurements were obtained using a Pulfrich refractometer. Sodium D light was employed after it was found that extrapolation to infinite wavelength was unnecessary. The procedure of Halverstadt and Kumler was employed involving extrapolations of dielectric constant, specific volume and the square of the refractive index to zero weight fraction. Least squares treatments were applied to the data.

Benzene solutions were prepared and dipole moments were obtained for metrazole (6.14 D), 8-tert-butylmetrazole (6.20 D), 8-sec-butylmetrazole (6.18 D), 1-cyclohexyl-5-methyltetrazole (6.00 D), megimide (2.84 D), m-dinitrobenzene (3.88 D) and p-nitro-N,N-dimethylbenzene (6.93 D).

No correlation between convulsant activity and dipole moment was apparent. The large moments of tetrazoles in general were discussed and there was noted the implication that the known data for the tetrazole moments could be consistently interpreted if the phenyl-nitrogen bond moment were greater than the methyl-nitrogen bond moment. The moment of megimide was found to be approximately consistent with the meager data available for imides in the literature. The electron density of the imide nitrogen appears rather profoundly reduced due to the  $\pi$ -bond interaction with the carbonyls.

Microfilm \$2.50; Xerox \$6.00. 125 pages.

#### CONDUCTANCE OF SOLUTIONS OF WATER, ACETIC ANHYDRIDE AND ACETYL CHLORIDE IN ACETIC ACID.

(L. C. Card No. Mic 60-5439)

Thomas Burdett Hoover, Ph.D.  
The Pennsylvania State University, 1960

Acetic acid having a specific conductance of 2.2 to  $3 \times 10^{-9}$  was prepared by fractional distillation and employed as solvent. Conductance and dielectric constant determinations on the solutions were made at 24.94°C and at frequencies of 500, 1000, and 2000 cps. The dielectric constants of solutions of water in the concentration range of  $1 \times 10^{-4}$  to 2 molal are represented by the equation  $D = 6.243 + 2.74 m_{H_2O}$ . Analysis of the conductance data for dilute solutions according to the Ostwald relation leads to the following estimates for the products  $K(\Lambda^\circ)^2$ : acetic acid,  $4.84 \times 10^{-12}$ ; water,  $1.56 \times 10^{-10}$ ; acetic anhydride, less than  $1 \times 10^{-11}$ ; acetyl chloride,  $2.5 \times 10^{-6}$ . Interionic attraction effects are negligible because of the very low ionic strengths of these solutions.

The data for dilute solutions of water did not give any evidence of a common ion effect due to the dissociation of the solvent although calculations showed that such an effect should be observable if present at all. In solutions of water more concentrated than about 0.1 molal the dielectric constant of the medium becomes a dominant factor in the conductance of the solutions. The effect has been quantitatively accounted for on the basis of the ion pair theory of Denison and Ramsey by the use of an "a" parameter of 5.5 Angstroms and  $\Lambda^\circ$  of 5. The correlation was made by treating the apparent dissociation constant of water as

a product of two factors, one representing the formation of ion pairs from the covalent bonds of the solute and the other representing the dissociation of ion pairs. Only the latter was assumed to be influenced by the variation of dielectric constant of the solution.

The possibility that water is not an electrolyte but increases the ionization of the solvent by breaking up acetic acid dimers was suggested by the absence of an observable common ion effect in dilute solutions but could not be reconciled with the results for more concentrated solutions. Microfilm \$2.50; Xerox \$5.20. 105 pages.

#### ZIRCONIUM(IV) COMPLEXES IN AQUEOUS SOLUTION

(L. C. Card No. Mic 60-4718)

Benjamin Joseph Intorre, Ph.D.  
Clark University, 1960

Supervisor: Arthur E. Martell

A variety of simple and mixed chelates of zirconium(IV) and hafnium(IV) were investigated potentiometrically. Mixed chelates with ethylenediaminetetraacetic acid (EDTA) or trans-cyclohexanediaminetetraacetic acid (CDTA) and disodium 1,2-dihydroxybenzene-3,5-disulfonate(Tiron), disodium-1,8-dihydroxynaphthalene-3,6-disulfonate(DNS), 8-hydroxyquinoline-5-sulfonate, oxalic acid, and acetylacetone were exceptionally stable. Evidence was obtained for a zirconium(IV)-EDTA 1:1 dimer, and also for a dimeric zirconium(IV)-EDTA-Tiron, 1:1:1 chelate.

In addition, formation constants were estimated for the zirconium(IV)-nitrilotriacetic acid 1:1 and zirconium(IV)-Tiron 1:1 chelates, and limits were set on the formation constant for the zirconium(IV)-EDTA 1:1 chelate, by means of the spectrophotometric competition method. The respective constants are: zirconium(IV)-nitrilotriacetic acid 1:1,  $\log K = 21.1 \pm 0.1$ ; zirconium(IV)-Tiron, 1:1,  $\log K = 25.2 \pm 0.2$ ; zirconium(IV)-EDTA, 1:1,  $\log K = 29.0 \pm 0.9$ . Equilibrium data for the hafnium(IV)-nitrilotriacetic acid, 1:1 chelate and the hafnium(IV)-EDTA, 1:1 chelate were obtained in a similar manner, but formation constants could not be calculated for lack of suitable hydrolysis data for hafnium(IV).

Microfilm \$2.50; Xerox \$3.00. 60 pages.



**PART I: AN INVESTIGATION OF THE  
SURFACE LAYERS OF POLYCRYSTALLINE  
THORIUM DIOXIDE BY ELECTRON DIFFRACTION.**

**PART II: THE STRUCTURE OF GASEOUS  
COPPER NITRATE.**

**PART III: THE MOLECULAR STRUCTURE  
OF IODINE HEPTAFLUORIDE.**

(L. C. Card No. Mic 60-4879)

Robert Eugene LaVilla, Ph.D.  
Cornell University, 1960

**PART I.**

As a consequence of the asymmetric polarization of the ions at the surface of an ionic crystallite, one may expect the interionic spacing in the surface layers to differ from that of the bulk. The interionic spacing difference would manifest itself in an asymmetry of the diffraction peak profile. Thorium dioxide prepared under three different sets of conditions was chosen to demonstrate the difference in lattice spacing. In addition, controlled impurity in the form of lanthanum oxide was introduced in one preparation with the hope of enhancing the difference of lattice spacing by establishing a concentration gradient of the impurity.

Sectored electron diffraction photographs of the polycrystalline samples were taken at 20 and 50 kilovolts, with thallous chloride and magnesium oxide as internal standards. No asymmetry of the peak profiles which could be attributed to a surface effect was detectable on the microdensitometer traces of the electron diffraction photographs. The lattice parameter measured in terms of the internal standard agreed with X-ray powder diffraction determinations of the same samples to within an average error of  $\pm 0.007 \text{ \AA}$ , set by variations in the electron diffraction data. The crystallite size sampled in the electron diffraction experiments, as estimated from the peak half widths, ranged from 35 to 70  $\text{\AA}$ , whereas in the X-ray diffraction experiments the size ranged from 70 to 370  $\text{\AA}$ .

The extent of asymmetry to be expected was estimated under the simplifying assumptions of a Maxwellian distribution of spherical crystallite sizes with a sharp boundary between the surface and bulk regions. In addition, the intensity distribution in a diffraction peak due to a particular lattice spacing was assumed to be Gaussian in shape. For a 50  $\text{\AA}$  thorium dioxide crystallite with a surface depth of about one unit cell, the computed asymmetry of the (220) reflection peak profile is less than 1% and would barely be observable.

**PART II.**

Anhydrous copper nitrate, which is unexpectedly volatile, has been shown to be monomeric by vapor density measurements and by mass spectrometry. Visually estimated intensities from non-sectored electron diffraction photographs of the vapor were used to compute a radial distribution function. Also, the observed intensity pattern was visually compared with calculated intensity curves for many molecular models. All structures in which the copper atom occupied a center of inversion showed poor correlation. The configuration which is in best agreement with the visually estimated diffraction pattern is based on  $\text{O}_3\text{N-Cu-O-NO}_2$ , with  $\text{Cu-N} = 1.98 \pm 0.03 \text{ \AA}$ ,  $\text{Cu-O} =$

$1.98 \pm 0.03 \text{ \AA}$ ,  $\langle \text{N-O} \rangle_{\text{av}} = 1.29 \pm 0.03 \text{ \AA}$ ,  $\angle \text{CuON} = 110^\circ \pm 5^\circ$ , and with both nitrate groups slightly nonplanar. These results are consistent with the structure of the solid, the slight differences in the infrared spectra between solid and vapor, and with the relative abundance of various ions recorded by the mass spectrometer.

**PART III.**

Sectored electron diffraction photographs of iodine heptafluoride taken in 1951 were reanalyzed using visually estimated intensities. In all the computations, allowance was made for the relative phase change of the scattering amplitudes between the iodine and fluorine atoms. The deduced I-F distances are approximately equal, with an average value of  $1.825 \pm 0.015 \text{ \AA}$ . In agreement with spectroscopic and crystal structure determinations, the molecular symmetry is almost  $D_{5h}$ . However, the electron diffraction patterns clearly indicate that the five fluorine atoms in the girdle are not coplanar and possibly are not equally spaced from the central iodine. The disorder reported in the crystalline state and the unusually broad NMR spectra of the liquid are readily accounted for by a sequential puckering about the polar axis and the possible out-of-phase extension from the axis of the girdle atoms. The thermodynamic functions of the ideal gas have been revised according to the deduced molecular structure.

Microfilm \$2.50; Xerox \$5.40. 110 pages.

**METAL-METAL ION EXCHANGE  
OF MERCURY AND SOME AMALGAMS**

(L. C. Card No. Mic 60-4673)

Richard Charles Legendre, Ph.D.  
The University of Tennessee, 1960

Major Professor: George K. Schweitzer

Studies of the rates of metal-metal ion exchange reactions at regulated temperatures were made using mercury or amalgams of cadmium, zinc or silver as a metal phase in contact with water solutions of the corresponding metal ions. Metal ions were in solution as the simple aquated specie (i.e., as the perchlorate), or in some chosen complexed form.

In most cases the exchange was followed by the disappearance of a radioactive form of the metal added to the solution. This disappearance was found to be representable by the relation  $\ln(1-F) = -kt$ , where  $F$  is the fraction of total possible exchange having occurred at time  $t$ , and  $k$  is a reaction rate constant for the exchange. Plots of  $\ln(1-F)$  versus  $t$  using experimental data gave straight lines passing through or very near the origin. Curves were fitted and rate constants were determined by the method of least squares.

In many cases the influence of temperature on the rate constant was determined. The behavior was found to be representable by

$$k = k_0 \exp(-E/RT).$$

The linear plots of  $\ln k$  versus  $1/T$  gave values for the experimental activation energy of exchange.

Studies were carried out on the effect on the rate of exchange of mercury(I) ion with mercury metal of: variation of solution concentration and amount of mercury agitated in the solution; utilization of controlled surface areas of mercury metal; variation of temperature; and addition of surface-active substances.

Experimental data were consistent with the diffusion in the solution phase being the rate-determining step in the exchanges which were performed. The experimental activation energy was determined to be 4.9 kcal./mole. The presence of surface-active substances during exchange caused a slowing of the process, probably due to the decrease in the effective surface area available for exchange.

Exchange studies similar to the above were performed in which amalgams of cadmium, zinc or silver were allowed to enter into exchange with solutions of their respective ions. The types of investigations made included the effect on the rate of exchange of the amalgamated metal with its ions of: prior sweeping of the solution with nitrogen gas; variation of the pH; variation of the metal ion and amalgam concentrations; variation of the temperature; addition of "inert" electrolyte; pretreatment of amalgam with a solution containing ions of the amalgamated metal; and addition of complexing agents.

The effect of the removal of atmospheric gases from the solution prior to exchange was to make experimental determinations more reproducible, and perhaps to lower the exchange rate slightly. Rates were found to be reduced as the solution acidity increased. Exchanges again appeared to be diffusion-controlled. Activation energies determined were 6.7 kcal./mole for the cadmium(II)-cadmium amalgam exchange, and 2.3 kcal./mole for the corresponding zinc system. Unexpectedly, it was found that the exchange rate was higher (cadmium system) in the presence of potassium perchlorate, and lower (zinc system) on stirring the amalgam with a solution of inactive ion prior to the monitored exchange. When complexing agents were added to the system, the exchange was found to be affected only slightly if weak to moderately strong complexes form. Changes in rate could be attributed to change in ion mobility. When stable complexes were formed, the rates were reduced more than could be explained in this manner. The de-coordination of ligands probably assumes importance in rate determination in such cases. Microfilm \$2.50; Xerox \$5.20. 104 pages.

#### AN INVESTIGATION OF THE THERMALLY INDUCED TRANSITION IN FIBRIN

(L. C. Card No. Mic 60-6509)

George Irwin Loeb, Ph.D.  
Cornell University, 1960

This work deals with the question of protein structure and denaturation. Denaturation is considered to be equivalent to disarrangements of an ordered native form of the protein. In the case of many polymers, a transformation of this type exhibits the properties of a phase change: in particular, a change in the external dimensions of the sample. The thermal shrinkage of films and fibers of the protein fibrin is considered from this point of view.

The previous model of Schellman for the denaturation of proteins has been extended to include the effect of pH upon side-chain hydrogen bonds, as evidenced by changes in the temperature of the transition. Experimental data to confirm the theory were obtained. Data on the effect of urea were also obtained and considered. The nature of the high-temperature form of the material was examined with respect to its elastic properties in an attempt to determine whether or not it was indeed amorphous in nature.

Microfilm \$2.50; Xerox \$7.20. 153 pages.

#### A STUDY OF THE RARE-EARTH CHELATE STABILITY CONSTANTS OF SOME AMINOPOLYACETIC ACIDS

(L. C. Card No. Mic 60-5888)

John Linn Mackey, Ph.D.  
Iowa State University of Science and Technology, 1960

Supervisor: Dr. J. E. Powell

The mercury electrode was used to study the interaction of the rare earths with some aminopolyacetate chelating agents. The stability constants of the rare earth chelates of N'-(hydroxyethyl) ethylenediamine-N,N,N'-triacetic acid, 1,2-bis-[2-di(carboxymethyl)-aminoethoxy] ethane, and 2,2'-bis-[di(carboxymethyl)-amino] diethyl ether were measured. The stability constant of the mercury(II) chelate of N'-(hydroxyethyl) ethylenediamine-N,N,N'-triacetate was also measured with the mercury electrode. This method was shown to yield results which were as accurate as other methods used to determine very stable chelate constants. Several protonated and bimetallic chelates of mercury were also studied.

An attempt was made to employ the mercury electrode as a pR electrode ( $pR = -\log [\text{rare-earth ion}]$ ) for the determination of rare-earth acetate formation constants. This method did not give good results probably because of the formation of bimetallic chelates. The formation constant for the addition of acetate to mercury(II)-N'-(hydroxyethyl) ethylenediamine-N,N,N'-triacetate was also determined.

Trends in the stability of the rare-earth aminopolyacetate chelates were discussed. Similarities in the stability constant curves of these chelates were noted. The "gadolinium break" appears to occur for nearly all the chelates studied. The position of yttrium in the stability constant curves and the "gadolinium break" may indicate ligand field stabilization of the 4f electrons.

Microfilm \$2.50; Xerox \$4.80. 94 pages.



## STUDIES IN MOLECULAR STRUCTURE.

I. THE MICROWAVE SPECTRUM  
AND MOLECULAR STRUCTURE  
OF MALONONITRILE.II.  $C^{13}$  SPLITTINGS IN PROTON MAGNETIC  
RESONANCE SPECTRA.

(L. C. Card No. Mic 60-4203)

Donald Earl Pritchard, Ph.D.  
Purdue University, 1960

Major Professor: Norbert Muller

The rotational spectrum of malononitrile, a compound whose structure is of interest as a test of possible hyperconjugative effects, was studied in the region from 17,000 to 30,000 mcs. Low J transitions were assigned to fifteen of the observed lines, and, from these assignments, accurate values for the three moments of inertia were calculated. Assuming values for three of the parameters of the molecule, the remaining three could be calculated. The results did not indicate the presence of any hyperconjugative effect in the molecule. However, an unambiguous structure must be obtained before such a statement can be considered conclusive.

Indirect spin-spin couplings between  $C^{13}$  nuclei and protons directly bonded to them were measured in the proton magnetic resonance spectra for a large number of simple organic compounds. The coupling constants were found to be related to the percentage s-character,  $\rho$ , of the carbon bonding orbitals by the simple semiempirical equation,  $\rho_{C-H} = 0.20 J_{C-H}$ . No evidence was found for a dependence of the coupling constants on supposed changes in ionic character of the bonds. On the basis of the results obtained, it was necessary to conclude that the state of hybridization of the carbon atom cannot be reliably inferred from the observed H-C-H angles in the molecules. This means that the bonds must in many cases be considered as somewhat bent. The coupling constants also were related to the carbon-hydrogen internuclear distances by the equation,  $r(C-H) = 1.1597 - 4.17 \times 10^{-4} J_{C-H}$ . This provides a new indirect means of evaluating many carbon-hydrogen bond distances with a reliability at least comparable with that of methods in current use. The aldehydic carbon-hydrogen bond distances calculated from the equation were found to be much shorter than the observed values, however.

The dependence of the coupling constants, and hence of the hybridization of the carbon bonding orbitals, in compounds of the type  $CH_3X$  upon the properties of the substituent group was also investigated. The results of this investigation could be correlated on the assumption that the effective electronegativity,  $E_x$ , and the size of the atom directly attached to the methyl carbon primarily determine the hybridization. The relationship,  $J_{C-H} = 22.6 E_x + 40.1 r(C-X) + 5.5$ , was obtained empirically.

The proton magnetic resonance spectrum of aluminum trimethyl- $C^{12}$  in cyclopentane at  $-60^\circ C$  was found to consist of two signals of two to one intensity ratio, as would be expected for the bridged dimer. As the temperature was increased, the peaks first broadened and then coalesced to a single sharp peak located at the weighted average of the low temperature shifts, a behavior characteristic of an exchange process. A study of the temperature dependence of the spectrum indicated that the energy

of activation for the exchange of the methyl groups between bridge and terminal positions is equal to  $13 \pm 2$  kcal./mole. Since the energy of dissociation of the dimer has been reported to be 20.2 kcal./mole, this indicates that the monomer is probably not an intermediate in the exchange process.

Microfilm \$2.50; Xerox \$7.00. 147 pages.

SOME EVIDENCE FOR  
THE CONFIGURATIONAL ISOMERIZATION  
OF HUMAN MERCAPTALBUMIN

(L. C. Card No. Mic 60-4205)

Michael Richard Rachinsky, Ph.D.  
Purdue University, 1960

Major Professor: Joseph F. Foster

Human serum albumin was observed to undergo a reversible isomerization within the low pH range of about 3.4 to 4.5 at low ionic strengths (e.g., 0.02 chloride) and  $0^\circ$ . That is, in this range two, and in a small part three, electrophoretic components were observed. The third component occurs at the expense of the faster of the original two components at around pH 3.85. The concentrations of these components varied systematically with change of pH. The two principal components were termed N and F. In plotting the percentage of either component, i.e., N or F, ( $F_1 + F_2$ ) versus pH, a sigmoidal curve was obtained which could be defined by the equation  $N + 3H \rightleftharpoons F$ .

The salting-out behavior of the protein at and below the pH of the N-F transition was observed. The precipitants used were lactate buffers containing a large concentration of sodium sulfate. The observed results yielded more evidence for the proposed isomerization. Assuming that the F form was less soluble than N, it was concluded that the low pH precipitation could be interpreted quantitatively on the basis of the reaction  $N + 3H \rightleftharpoons F$ .

A study of the complex formed by the reaction of HMA with trichloroacetic acid was performed in order to provide more insight regarding the forces which are involved in the configurational adaptability and conglobation of the macromolecule. Optical rotation and sedimentation investigations were performed on the HMA-TCA complex dissolved in aqueous-ethanol systems. These studies revealed that reversible configurational changes apparently occurred in both the tertiary and secondary structures of HMA. No intermolecular associations were observed. However on long standing (ca. one month) at  $2 \pm 1^\circ C$ , aggregation was observed in aqueous ethanol solutions of the complex. Exhaustive dialysis of the complex into low ionic strength aqueous systems yielded HMA with electrophoretic, optical and sedimentation properties identical to those of the native protein.

Experimentation was also carried out on the aggregation of HMA at and below the pH of the N-F transformations. Aggregation was observed in 0.1 and 0.05 ionic strength chloride systems but not in systems of 0.02 ionic strength chloride. Aggregation was not observed in 0.1 - 0.2 M lactate systems in this pH range. However, the N-F transition and the "expansion" were observed to occur in lactate solutions of these concentrations. Lactate also

apparently inhibited the aggregation which normally takes place in the presence of urea. Evidence was presented which indicated that the low pH aggregation is dependent on a free sulfhydryl group of the serum albumin molecule.

Attempts were made to separate the HMA molecule into subunits by (a) limited proteolysis and (b) chemical reduction of disulfide linkages. While these studies were not entirely successful in terms of the initial objective they did lead to several interesting observations. In particular, further studies were made of the protein-protein complex between HMA and pepsin. It was concluded that a weak complex persists, after precipitation near pH 4, in the pH range 5.6 - 6.8 ( $K \approx 10^{-1}$ ). Sodium borohydride, 2-mercaptoethanol and other reducing agents were employed for the reduction of the HMA-TCA complex in aqueous-organic solvent systems.

Microfilm \$2.50; Xerox \$5.80. 119 pages.

#### ELECTROCHEMICAL AND ACID-BASE STUDIES IN DIMETHYLSULFOXIDE AS SOLVENT

(L. C. Card No. Mic 60-5606)

Thomas Bradley Reddy, Ph.D.  
University of Minnesota, 1960

Adviser: I. M. Kolthoff

The present study has been confined to the preparation of pure solvent, polarography of some acids and other substances, and voltammetry at the rotated platinum electrode. In addition the dissociation constants of several acids and an uncharged base have been determined and an estimate has been made of the solvolysis constant of the solvent.

A purification procedure consisting of treatment with anhydrous alumina followed by fractional distillation at reduced pressure has been developed. This method is definitely superior to any previously described. Polarographic studies on the reduction of acids in DMSO show that  $\text{HClO}_4$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HCl}$  are all strong monoprotic acids. Well-defined current-voltage curves are also obtained for these acids at a rotated platinum electrode and this can be made the basis for the amperometric titration of bases. The polarography of quinones in DMSO indicates that these compounds are reduced by a complex mechanism and that quinone-hydroquinone couples cannot be used to indicate the pH of solutions in DMSO. Several metal ions have been studied polarographically and the results indicate that the transition metals are reduced irreversibly with a large overpotential while the alkali metals are reduced reversibly. Some preliminary studies were carried out with a rotated mercury pool electrode and with a rotated dropping mercury electrode. The results, while interesting, are inconclusive.

Spectrophotometric studies using indicators have given the pK values for a number of acids and indicators in DMSO. In general, carboxylic acids are about 5 pK units weaker in DMSO than in water. Benzein and sulfone-phthalein indicators are weaker by 2.7 pK units. Picric acid is considerably stronger in DMSO than in water. Bisulfate ion is very much weaker in DMSO than in water.

The cationic acids are slightly stronger in DMSO indicating that the solvent is a base comparable to water.

Conductance measurements were made to show that  $\text{HCl}$  is fully dissociated in DMSO and that the  $\text{pK}_B$  for di-n-butylamine is 7. EMF measurements using a glass electrode have been made on solutions of acids. A silver, silver chloride, sodium chloride reference electrode was found to be useful in DMSO. The pK values observed agree with the spectrophotometric data. The pK of di-n-butylammonium chloride has been determined and the autoprotolysis constant of DMSO was found to be  $5 \times 10^{-18}$ . DMSO is a very much weaker acid than water.

Titration in DMSO have been studied briefly. The addition of concentrated aqueous hydroxide to DMSO results in decomposition of the solvent. DMSO must be judged unpromising as a solvent for titration purposes.

While this study has disclosed many interesting problems involving the solvent properties of DMSO, much more work is necessary in this field before all results can be explained.

Microfilm \$3.15; Xerox \$11.05. 243 pages.

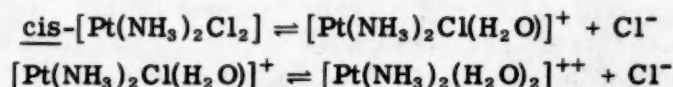
#### AQUATION AND ISOTOPIC EXCHANGE OF THE CHLORIDE LIGANDS OF THE CIS-DICHLORODIAMMINEPLATINUM(II) COMPLEX

(L. C. Card No. Mic 60-5889)

John William Reishus, Ph.D.  
Iowa State University of Science and Technology, 1960

Supervisor: Don S. Martin, Jr.

The acid hydrolysis of  $\text{cis-}[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$  may be described as



The concentration equilibrium constant for the first hydrolysis step,  $K_1$ , was determined, within 10%, to be 3.9, 3.3, and  $3.3 \times 10^{-3}$  moles/l. at 35.0°, 25.0°, and 15.0° C., respectively. Also the rate constant for this initial aquation step,  $k_1$ , was found to be .72, .25, and  $.08 \times 10^{-4} \text{ sec}^{-1}$  at the three temperatures, respectively. The temperature dependence of  $k_1$  indicated that  $H_1^\ddagger = 17.4 \text{ kcal./mole}$  and  $S_1^\ddagger = -12 \text{ cal./mole deg}$ .

The concentration equilibrium constant for the second hydrolysis step was determined, within 30%, to be 2.0, 4.4, and  $1.6 \times 10^{-4}$  moles/l. at 35.0°, 25.0°, and 15.0° C., respectively. The second aquation rate constant,  $k_2$ , at 25.0° C. was approximately  $.35 \times 10^{-4} \text{ sec}^{-1}$ .

The exchange of  $\text{Cl}^-$  with  $\text{cis-}[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$  was found to follow first order kinetics in the complex, zeroth order kinetics in chloride, and to proceed via the first aquation step shown above. The exchange of  $\text{Cl}^-$  with  $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{H}_2\text{O})]^+$  was characterized by the same kinetics and was found to proceed by a chloride independent process which could be assigned to the second aquation step shown above.

Microfilm \$2.50; Xerox \$3.60. 64 pages.



A STUDY OF THE REACTIONS  
OF IONS AND ION-PAIRS  
IN ALLYLIC SYSTEMS

(L. C. Card No. Mic 60-6130)

Arnold Morry Rosenberg, Ph.D.  
Purdue University, 1960

Major Professor: Richard A. Sneed

The solvolyses of the isomeric  $\alpha$ -phenyl- $\gamma$ -methyl- and  $\alpha$ -methyl- $\gamma$ -phenylallyl *p*-nitrobenzoate have been studied in order to determine the resulting distribution of products under various conditions with a view toward unravelling the details of the mechanism of these reactions. By a combination of kinetic and ultraviolet spectrophotometric techniques we were able to determine that these isomeric esters give the same product distributions on methanolysis; of the ethereal products each ester furnished 39% of  $\alpha$ -phenyl- $\gamma$ -methylallyl methyl ether and 61% of  $\alpha$ -methyl- $\gamma$ -phenylallyl methyl ether. Substitution of a *p*-methyl group into the phenyl ring of the  $\gamma$ -phenyl ester had no discernible effect on the product distribution;  $\alpha$ -methyl- $\gamma$ -*p*-tolyl *p*-nitrobenzoate underwent methanolysis to furnish the corresponding solvolysis products of which  $\alpha$ -*p*-tolyl- $\gamma$ -methylallyl methyl ether constituted  $37.5 \pm 1.5\%$ .

When the solvolysis of  $\alpha$ -phenyl- $\gamma$ -methylallyl *p*-nitrobenzoate was conducted in 60% aqueous dioxane,  $\alpha$ -phenyl- $\gamma$ -methylallyl alcohol composed only ca. 16% of the solvolysis product mixture. When these solvolyses were carried out in the presence of sodium azide, alkyl azides were formed by a carbonium ion process. Sodium azide was found to have essentially no effect on the total rate of reaction nor did it depress significantly the amount of rearranged ester produced during the solvolysis of  $\alpha$ -phenyl- $\gamma$ -methylallyl *p*-nitrobenzoate. Most of the alkyl azide arises at the expense of allyl ethers (in methanol) or alcohols (in aqueous dioxane). Azide ion was found to compete with solvent more than three times as effectively for the *p*-tolylmethylallyl carbonium ion as for the phenylmethylallyl carbonium ion.

From the facts that substitution of a *p*-methyl group into the phenyl ring of these esters had no discernible effect on the product distribution, but had an appreciable effect on the amount of alkyl azide formed, we conclude that charge distribution in the carbonium ion is an important factor in determining the rate of nucleophilic attack at the two allylic centers, but that this substitution affects the electronic distribution at both centers similarly.

It is shown that, both in methanol and in aqueous dioxane, only one of the two possible allylic azides is produced in measurable amounts; the  $\alpha$ -methyl- $\gamma$ -arylallyl azides are formed to the exclusion of their allylic isomers.

A kinetic argument is developed which establishes definitely an ion pair as an intermediate in these solvolysis reactions. The reactivity of this ion pair intermediate was investigated and it is shown that neither solvent nor azide ion is capable of attacking it at a rate commensurate with its rate of dissociation.

In the course of this research an example of the rarely

observed  $B_{Al}^{12}$  mechanism of ester hydrolysis was uncovered.

Microfilm \$2.50; Xerox \$6.00. 125 pages.

PREPARATION AND CHARACTERIZATION OF  
MULTILAYER MEMBRANE ELECTRODES.

(L. C. Card No. Mic 60-6428)

Harold Schonhorn, Ph.D.  
Polytechnic Institute of Brooklyn, 1959

Adviser: Harry P. Gregor

Multilayers of the alkaline earth salts of stearic, hexadecyl- and octadecylsulfuric and hexadecylorthophosphoric acids were prepared on two halves of a previously cracked glass slide. Fifty monomolecular layers were plated out on each half-slide, which were subsequently cemented together to form a multilayer membrane electrode, such that alkaline earth cations could diffuse through the membrane from one contiguous solution phase to another in a direction normal to the axis of orientation of the long-chain acids. These electrodes had ohmic resistances ranging from 20 to  $60 \times 10^6$  ohms for a given area of membrane (2 cm.  $\times$   $2.5 \times 10^{-5}$  cm.), possessing a specific resistance of  $2 \times 10^4$  ohm-cm. Potentials of double concentration cells containing varying concentration ratios of Ca(II), Ba(II) and Fe(III) salts were measured, and found to agree closely with ones calculated for membranes ideally ion-selective for the cationic species. These membranes acted ideally in the range of ionic strengths from  $3 \times 10^{-4}$  to 15, or greater.

Ion-specific multilayer membrane electrodes were also employed in the measurement of activities of calcium or barium chlorides in solutions of mixed electrolytes containing sodium or potassium chlorides. The same preparative techniques could be employed for electrodes which were reversible only to the alkaline earth cations in solutions of mixed electrolytes with the alkali metal cations, provided that the molar ratio of the latter to the former did not exceed about 20:1. It was demonstrated that, in these mixed electrolyte systems, the activity coefficients were always greater than that of the corresponding pure 2-1 electrolyte at the same total ionic strength. A rise in the mean ion activity coefficient was noted as the concentration of the 2-1 electrolyte diminished.

For varying ratios of calcium chloride to potassium chloride at a fixed total ionic strength of 0.0003, the constancy of the mean ion activity coefficient for calcium chloride was demonstrated. This was a direct experimental verification of the Debye-Hückel limiting law.

Harned's Rule was tested for a number of systems for which there were no previous data due to the non-existence of appropriate reversible electrodes.

In cases where the ratio of alkali metal cation to alkaline earth cations was greater than 50:1, special preparative procedures were required. It was found necessary to protect the multilayer by backing up both

sides of the multilayer membrane electrode with an ion-selective membrane plus a porous material. The entire assemblage was contained in a plastic device and a pressure applied by means of a vice. With this technique concentration chains involving ratios of an alkali metal cation to an alkaline earth cation of 100:1 could be measured.

The ion-specificity of multilayer membrane electrodes was established for solutions containing calcium or barium chloride in the presence of varying amounts of potassium or sodium chloride. The multilayer membrane electrode may be considered to be a generalized membrane electrode, specific for a particular ionic species in the presence of other ionic species of the same charge.

Microfilm \$2.50; Xerox \$4.80. 93 pages.

#### SOME ASPECTS OF THE OXIDATION OF POLYETHYLENE

(L. C. Card No. Mic 60-5374)

George Wilfrid Tarbet, Ph.D.  
University of Delaware, 1960

Supervisor: Harold C. Beachell

The atmospheric oxidation of a number of polyethylenes of varying properties has been investigated at elevated temperatures. The polymers, which included branched, linear and deuterated,  $-(CHD)_n-$  and  $-(CD_2)_n-$ , polyethylenes, were oxidized in the form of thin films in the temperature range of 130 to 200°C. The deuterated samples and one linear sample were polymerized in the laboratory, the others being from commercial sources.

The scope of the investigation was limited to following the production of carbonyl groups during the course of oxidation. To do this, a Perkin-Elmer Model 13 high resolution infrared spectrophotometer equipped with a grating to cover 5 to 7 microns was used. The instrument was calibrated by use of the water vapour spectrum and carbonyl compounds of known wavelength. It was hoped that the high resolution would aid in the unequivocal identification of the groups producing absorption bands but the broadness of the bands prevented this to a large extent.

Both the branched and linear polyethylenes appear to

oxidize by substantially the same mechanism. The first band appearing is at a wavelength near that for internal ketones in a long chain, but the absorption rapidly shifts towards that for carboxyl groups. This band is ascribed to the combined absorptions of ketones and acids. Subsequently another band appears at a wavelength corresponding to that for esters and is due to the combination of carboxyl and hydroxyl groups to form esters. The deuterated samples, being more resistant to oxidation, indicate that in addition to ketones, aldehydes are probably also formed from the hydroperoxides by a chain scission reaction, as opposed to the straight oxidation producing ketones. Normally the aldehydes oxidize to acids which may form esters.

The thickness of the films of the branched and linear polyethylenes was controlled by using the absorption of the methylene group vibration at 6.85 microns as a control. After applying suitable corrections the absorbance of the various carbonyl groups was plotted against time. The plots were S-shaped with an apparent induction period followed by a fast reaction with linear slope and finally almost constant absorbance. From the slopes of the fast reactions, apparent activation energies were calculated using the Arrhenius equation. The lower values for the more linear materials, in the range 18 to 28 Kcals. per mole, suggests a greater ease of oxidation than for the branched polymers, 28 to 38 Kcals. per mole. This can be explained in terms of crystallinity differences of the two types of material. The branched polymers have more amorphous regions which oxidize fairly readily and shows as a gradually increasing curve. At some point the crystalline region starts to oxidize and once the crystallinity is destroyed the oxidation is rapid. Since the linear polyethylene is predominantly crystalline it has a longer period of slow oxidation before the crystalline region starts oxidizing. There being more of this the greater is the oxidation at this stage and the slope is steeper. Also there is not much difference between the rates of oxidation at the various temperatures and so the apparent activation energies are lower.

Thus it is concluded that the more amorphous branched polyethylenes are more susceptible to oxidation initially than the more crystalline linear materials but once the crystallinity is impaired in some way, the linear polymers oxidize more rapidly and to a greater extent. The actual reason for this and the mode of attack, however, is still not perfectly clear.

Microfilm \$2.50; Xerox \$4.80. 93 pages.



## ECONOMICS

### ECONOMICS, GENERAL

#### OCCUPATIONAL MOBILITY OF AMERICAN ECONOMISTS: A REPORT ON THE SURVEY OF PATTERNS AND FACTORS IN THEIR MOBILITY.

(L. C. Card No. Mic 60-5708)

Venkatraman Anantaraman, Ph.D.  
The University of Wisconsin, 1960

Supervisor: Associate Professor David B. Johnson

The survey was sponsored by the Industrial Relations Research Center, University of Wisconsin, and was based on a sample of the size of 440 randomly selected from a population of eminent male economists who were listed in the biographical Directory of American Men of Science, 1956. The data were collected through the instrumentality of a questionnaire mailed out to these economists on February 2, 1960, and the report is based on the analysis of 280 usable returns. The report is free from non-response bias.

The main objectives of the study were to ascertain:

1. the extent and patterns of mobility of economists in all its aspects;
2. the broad reasons for their moves from the academic to non-academic fields and vice versa,
3. the sources of job-information available with a view to assess their adequacy or inadequacy,
4. whether or not mobility has served as a ladder for self-improvement, and finally,
5. the social origins of economists and occupational succession through an analysis of the occupations of their fathers and of their fathers' fathers.

#### Results

1. The population surveyed was totally different from a general population of economists.
2. A progressive retardation of movement with advancing age was strongly evident, but the relation between rate of mobility and marital or family status or length of professional experience was inconclusive.
3. Like other classes of workers economists indulged in "shopping around" activity in the initial years of employment, but such activity was not only widespread among them, but extended beyond the first five years. Although economists were more mobile in the first ten years than they were after, they displayed definite signs of stability only after first fifteen years of employment.
4. Economists were relatively more stable than unskilled, semi-skilled and skilled workers as well as most of white collar workers. They were slightly less stable

than professional workers in general but more stable than scientists.

5. Economists were far more mobile during the decade 1940-50 than they were in the next decade, 1950-60.

6. During the various periods considered, only a minority of economists contributed to a major portion of total job changes but neither the minority was so small nor the portion of total job-shifts they accounted for was so high as in the case of other classes of workers.

7. Movements between fields of employment were classified under four definite sets of patterns: linear, circular, revolving, and random patterns, and this descriptive tool was employed to trace the path of their inter-field mobility.

8. Geographic flexibility was analysed from various angles and economists were found to be highly mobile between states, sections, and regions of the United States. It was also shown that economists could adjust to far-reaching changes in geographic distribution of man-power requirements caused by factors such as war and mounting waves of student enrollments.

9. Although the existing sources of job-information were obtained through non-agency sources which were, by and large, unorganized, economists seemed to feel they were adequate. However, a plea for organizing the labor market for economists was made, and an independently endowed professional employment agency suggested.

10. Analysis of causes of mobility and reasons for stability showed that the problem of staffing institutions of higher education with adequate and efficient economics faculty was not formidable.

11. Mobility seemed to have effectively performed its function as a ladder for self-improvement, meaning professional growth, and this had important implications with reference to efficient utilization of man-power resources.

12. Finally, the problems of inter-generational mobility was examined with reference to occupational succession through the male line over three generations, and this enabled us to answer in the affirmative the question of fluidity of the United States occupational structure with special reference to the profession of economists.

Microfilm \$3.00; Xerox \$10.35. 230 pages.

#### A STUDY OF WYOMING'S WORKMEN'S COMPENSATION SYSTEM, 1915-1956.

(L. C. Card No. Mic 60-4717)

Edmond Leon Escolás, Ph.D.  
Clark University, 1960

Supervisor: Dr. F. Eugene Melder

In response to a movement which swept the nation, Wyoming, in 1915, enacted a Workmen's Compensation Act

as a solution to the economic problem of industrial accidents and deaths. The Act's proponents hoped to achieve in the long run not only adequate compensation for the industrially injured and their families, but also a program of accident prevention and vocational rehabilitation.

After more than forty years of operation of the compensation system, sufficient experience has been had to provide an ample base for a long-run critical analysis of the major lines of compensation, accident prevention, and vocational rehabilitation. If upon thorough examination, Wyoming's Act fails to measure up to criteria of acceptability for workmen's compensation, then possible revisions will be suggested which will bring the Law into more conformity with the demands of changing social values and economic conditions.

Two approaches are used to develop the subject matter of this study, the descriptive and the functional. The descriptive is employed to amass and classify economic, historical, political, and social data of a factual nature. The functional method includes activities which analyze, compare, correlate, and appraise the operations of the system and its accomplishments. The functional approach will be emphasized in order to better evaluate Wyoming's Compensation Act as it operates today in our economic, social, and political environment.

To evaluate the effectiveness of Wyoming's Act, certain basic criteria are established in order to have a straightforward means of examining the operation of the various parts of the Act.

The first criterion relates to coverage. Authorities agree that compensation legislation is economically, politically, and socially the best method for coping with industrial accidents, deaths, and diseases. The ideal standard is that a state's workmen's compensation coverage should be as inclusive as the risks of the employed work force.

The second criterion is that of adequacy. Workmen's compensation benefits should be "adequate." Although "adequacy" is a yardstick of performance, it is imprecise. While value judgments enter the picture in certain areas, there are some aspects of benefits adequacy about which there can be no legitimate differences, such as unlimited prescribed hospital and medical benefits. Granted that incentive effects must be taken into consideration, a comparison of compensation benefits received under various types of injuries with average wages for that occupation may serve as a standard for "adequacy."

Another criterion pertains to the efficiency of the system's administrative performance. Performance is judged on how promptly, effectively, and inexpensively the specialized functions of workmen's compensation are administered in accordance with the main goals of compensation, prevention, and rehabilitation. A strictly economic criterion which relates benefit payments to employer costs supplements this analysis.

Results of the study indicate that coverage, limited to the legally enumerated extra-hazardous employments, is far below the ideal standard as well as the coverages offered in the comparison states of Montana and New York.

Except for hospital and medical expenses, Wyoming's indemnity benefits are generally inadequate measured by almost any scale. Occupational disease still remains uncompensated. There is an absence of any effective rehabilitation program.

Wyoming's hybrid administrative system is inefficient and costly. Court administration remains an anachronism. State administration is engulfed in paperwork rather than serving as an agency to further compensation goals. Accident prevention is neglected. The Fund system lacks scientific rating of risks while continuing to build up an unwieldy surplus.

The broad conclusion of this study is that the political community of Wyoming is distributing the burdens and social costs of industrial accidents in a manner which falls short of an optimum, both on principles of effective employment of resources and social equity.

Microfilm \$5.25; Xerox \$18.45. 410 pages.

#### ON RESEARCH AND DEVELOPMENT BUDGETING AND PROJECT SELECTION

(L. C. Card No. Mic 60-5540)

Sidney Wayne Hess, Ph.D.  
Case Institute of Technology, 1960

Contemporary models of research and development are incomplete in that they ignore the many reappraisals and budgeting decisions that occur in the time between a project's proposal and its commercialization. The sequential decision aspects of project budgeting are particularly important since (a) the research expenditure is usually an order of magnitude less than the irrevocable investment for commercialization and (b) an allocation to a project today does not presuppose continuation of the project into future periods.

After examining the merits and deficiencies of conventional allocation models, the budgeting problem is restructured to take into account the sequential decision characteristic. Utilizing the technique of dynamic programming, methods are developed to determine optimal project budgets when the aggregate research and development budget is either constrained or unconstrained. These models also suggest a rational explanation of the patterns of project expenditures over time that one observes in practice.

Finally, the research process is shown to be analogous to a queuing process. As such the techniques of queuing theory may be efficiently utilized for budgeting and project selection where (a) a large number of similar projects are worked and (b) their success is reasonably certain.

Microfilm \$2.50; Xerox \$7.00. 146 pages.

#### THE USE AND INTERCHANGEABILITY OF FUELS IN PENNSYLVANIA

(L. C. Card No. Mic 60-5440)

Walter Gibson Jaworek, Ph.D.  
The Pennsylvania State University, 1960

Interchangeability of fuels is a topic of current interest not only to the fuel producer and fuel consumer, but also to the state and federal governments. The present



oversupply of fuels in the United States, together with long-term forecasts of diminished energy supplies, has suggested to many that a better understanding of energy utilization trends and characteristics is needed.

The purpose of this study is to determine the proportion of current energy usage in Pennsylvania which can be satisfied by more than one of the major primary fuels--bituminous coal, anthracite, petroleum, and natural gas. Fuel substitution possibilities in this study are defined as of either "existing," "feasible," or "impractical" interchangeability.

Since there is no standard classification of fuel utilization in common usage, a method is presented which classifies fuel consumption into six categories which are easily measured from standard statistical sources. These categories are industrial, electric generation, residential, commercial, transportation, and the mineral industries. Time series are presented showing yearly fuel consumption for each of the major primary fuels in Pennsylvania since 1937. A composite model of the present structure of the state's fuel economy is then determined which serves as a basis for measuring fuel interchangeability.

Various marketing research techniques were used in the experimental phase of the study, including the mailed questionnaire, the case study method, and statistical analysis. As much as possible, analysis of interchangeability in each consumption category was based on data taken directly from the fuel consumer.

Industrial fuel consumption accounts for about half of all energy use in Pennsylvania. The fuel requirements of integrated iron and steel companies, the largest industrial group, are mostly satisfied by coke and its various by-products, although other fuels are also consumed in substantial quantities. Nonintegrated or fabricating steel companies consume mostly natural gas and fuel oil. Manufacturing companies, the vast majority of the state's industrial firms, use all types of fuels. High degrees of existing and feasible interchangeability are available in industrial fuel use, particularly among non-integrated steel companies and the larger manufacturers. However, the impractical interchangeability of coke in iron production still represents 40 per cent of total industrial fuel consumption in Pennsylvania.

Energy demand in the electric generation, residential, commercial, and transportation categories increased sharply in Pennsylvania in the postwar years. Almost complete interchangeability of fuel is possible in electric generation and residential usage, although only about 10 per cent of consumption can be classified as of existing interchangeability. Utility electric generating plants, which produce over 85 per cent of the state's power, have less existing interchangeability in fuel use than nonutility (industrial) generating plants. Existing interchangeability in the residential and commercial sectors was measured as the percentage of fuel consumers who purchase new heating equipment in an average year. All fuel consumption for transportation was classified as of impractical interchangeability, as was 95 per cent of the energy use in the mineral industries.

Fuel selection and interchangeability by the individual fuel consumer are dependent on the interrelation of various groups of factors, including geographic, economic, and physical and intangible considerations. Although there are four distinct fuel supply areas in Pennsylvania, the geographic influence of these areas varies in the different

energy markets. Fuel costs and investment expenditures are the two most important economic considerations in fuel selection. Convenience or performance characteristics of a fuel are important to the consumer, but they are usually not controlling factors in present fuel selection.

The results of this study show that 17 per cent of all energy use in Pennsylvania is of existing interchangeability, 49 per cent of feasible interchangeability, and 34 per cent of impractical interchangeability. No significant changes are foreseen in the patterns of fuel utilization in the state in the near future.

Microfilm \$2.60; Xerox \$9.00. 198 pages.

#### AN EVALUATION OF THE BALANCE SHEET APPROACH TO THE THEORY OF THE FIRM

(L. C. Card No. Mic 60-5683)

Albert Alonzo Montgomery, Ph.D.  
State University of Iowa, 1960

Chairman: Professor Clark C. Bloom

The primary purpose of this study is to examine and evaluate Kenneth Boulding's balance sheet approach to the theory of the firm in light of the post-World War II criticisms directed at the textbook theory of the firm. The evaluative viewpoint of the study is that of the economist who is primarily concerned with the firm in its relationship to the economic process. Accordingly, the question posed by the study is whether Boulding's balance sheet formulation constitutes a useful alternative to static theory as an abstract starting-point from which the economist can consider the complexities of resource allocation in a dynamic economy.

The first step in the procedure followed by the study is to present the textbook theory of the firm under conditions of perfect competition and monopoly with emphasis on the role of the firm in the functioning of a static economic system. Criticisms of the static assumptions underlying the orthodox theory are then considered with notice given their relevance to a balance sheet approach to the firm. Following this is a survey of the balance sheet views held by accountants and capital theorists. Against this background, Boulding's balance sheet models are examined and compared with those of capital theorists. The final section of the study, pursuing the approach of conventional capital theory, presents a modified version of the static theory. In this version, which depicts the firm in Gustav Cassel's "uniformly progressing economy," investment is seen to be an integral part of the firm's short-run operating plans.

The major conclusion reached by the study is that Boulding's ingenious approach to the theory of the firm is not as useful, as an abstract starting-point for the general economist, as that provided by conventional capital theory.

Microfilm \$5.35; Xerox \$18.90. 417 pages.

# ACTIVITY ANALYSIS AND THE THEORY OF THE FIRM

(L. C. Card No. Mic 60-5689)

Gerald L. Nordquist, Ph.D.  
State University of Iowa, 1960

Chairman: Clark C. Bloom

Controversy over the traditional approach to micro-economic problems has had a profound effect upon its pre-eminence. The theory of the firm itself has been directly and indirectly attacked from almost every conceivable quarter. Of course, the most damaging charge of all is that the traditional model is directly contradicted by the facts of modern business organization.

In view of the many shortcomings of the theory of the firm, the aims of this study are indeed modest. The principle objective is to provide an intensive inquiry into the nature of market adjustments given two distinctly different concepts of production organization:

- (1) Production technology is of the conventional form--a smooth, continuous relationship between several inputs and outputs.
- (2) Production technology takes the form of a finite number of discrete input-output choices.

The first concept is a basic presupposition of the marginal approach to the theory of the firm. The second arises out of the development of the activity analysis (linear programming) method of operations research.

This study is divided into two parts. Part 1 examines in detail the nature of the conventional analysis of business behavior and begins with a brief, general critique of the traditional theory. Particular stress is placed upon the matter of production technology in a highly condensed statement of equilibrium and stability conditions. Various features of conventional production functions are examined. Of special interest are three case studies of production equilibrium where production functions are all linear homogeneous.

Part 2 contains a detailed restatement of the equilibrium of the firm via the method of activity analysis. The work is designed to parallel the conventional analysis closely: First, the activity or process type production function is examined to expose the nature of factor substitution, output returns, and returns to scale. Second, quantitative limits upon the availability of resources are superimposed upon the purely technical conditions inherent in the shape of activity technology. Third, the equilibrium of the firm is reformulated and its stability features are exposed. Finally, the model is placed in a dynamic setting for a cursory appraisal of the implications of growth and imperfect competition.

The activity model of business behavior seems to be well suited to decision-making at the level of the firm. It does not replace the conventional analysis, but it can be viewed as an important alternative which has several distinct advantages. While the activity model does not suggest principles or theorems which vary significantly from those given by the traditional analysis, it does provide greater specification of internal conditions and, hence, an improved insight into the nature of business behavior.

It must be acknowledged that many of the criticisms which have been directed against the traditional theory of

the firm must also apply to the activity model. The assumption of profit maximization, the idea of equilibrium, the emphasis upon technical characteristics--are integral parts of both analytical approaches to business behavior. In short, the activity model of the firm lies squarely in the tradition of economic theory.

Microfilm \$2.85; Xerox \$9.90. 219 pages.

# AN ANALYSIS OF THE MOTOR VEHICLE INDUSTRY AS A FACTOR IN THE ECONOMIC LIFE OF CANADA

(L. C. Card No. Mic 60-3988)

Robert Allen Robertson, Ph.D.  
University of Illinois, 1960

This study has been conducted in five major stages, as follows:

1. The general background of the Canadian economy during 1926-1955, along with the history of the Canadian motor vehicle industry from its beginning, in 1904, to 1926;
2. A comparison of the production of the Canadian motor vehicle and parts industries with all manufacturing industries in Canada, with respect to relative ranking in product value, materials cost, wages and salaries, average employment, and number of plants;
3. Imports, exports, and re-exports of the Canadian motor vehicle industry compared with total Canadian imports and exports, tariffs, and the effects of the foreign trade in motor vehicles and parts on the Canadian economy;
4. Motor vehicles and associated products in Canadian retail and wholesale trade, annual sales of motor vehicle dealerships, garages, and filling stations as compared with sales of all retail establishments, effects of the retail sales of new and used passenger automobiles on the Canadian economy, and changes in the methods of transporting motor vehicles to the retailers;
5. General Canadian consumption patterns, comparison of Canadian expenditures on motor vehicles, automotive operating expenses, and other transportation with expenditures on durable and non-durable goods and services and with consumption patterns in the United States, and the effects of economic fluctuations in the two economies on the components of aggregate consumption expenditures.

The general approach used includes converting the data to inter-census or year-to-year changes for purposes of comparison. Also, percentages were used to render the various categories more comparable with one another, especially when there were significant differences in the relative sizes of the categories or when comparisons over time were being made.

Two major conclusions are indicated by the data presented: first, a truly domestic Canadian motor vehicle industry has not developed; and second, marked changes



have taken place in consumer demand for motor vehicles and goods associated with their use. The Canadian motor vehicle industry is almost exclusively a branch plant extension of the United States motor vehicle industry. This failure to develop a truly domestic industry in Canada appears to result primarily from the limited existing and potential market in Canada. Thus, the size of the market imposes ceilings on economies of scale. Furthermore, the greater United States experience, technical know-how, and patents put Canada at a disadvantage in competing with the United States. Canadian tariffs explain the presence of United States firms in Canada. The changing role of the motor vehicle in Canada parallels the experience of the United States. The study indicates that the income elasticity of demand for motor vehicles is high in Canada, while the price elasticity of demand appears to be moderate. The motor vehicle has assumed a position of prominence in the Canadian economy, and that position is growing stronger. Microfilm \$3.40; Xerox \$11.95. 264 pages.

FACTORS ASSOCIATED WITH CHANGES  
IN CLOTHING EXPENDITURES IN THE  
UNITED STATES, 1929-1958.

(L. C. Card No. Mic 60-4911)

Thora Geitel Winakor, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: Margaret I. Liston

During the 30 year period 1929 through 1958, clothing expenditures in the United States declined as a share of total expenditures for consumption. Many explanations had been proposed by researchers, whose results tended to be negative or inconclusive.

Data from the United States Department of Commerce and annual summaries of Illinois farm family accounts were used to examine two questions: 1) was the downward time trend in clothing expenditures associated with changes in static elasticity for clothing over the period, and 2) could the decline be attributed to the interaction of shifts in consumer tastes with quality changes in clothing? The farm family accounts provided data for the 30 years, giving clues to possible factors affecting expenditures of larger population groups for which complete records were unavailable.

No evidence was found that the slope of Engel curves for clothing of the Illinois farm families had changed over time. Static elasticity of clothing with respect to total expenditure remained at approximately unity for the period 1929-1958. Data to test this hypothesis for the United States were lacking.

Time series indicated a downward trend in clothing expenditures both for the United States and for the Illinois farm families. This was evident in the shape of indifference curves and in regression models. Inclusion of time in the model was required if it was assumed that non-static elasticity coefficients must be equivalent to static elasticity coefficients for expenditure. Price did not appear to be an important determinant of clothing expenditures.

Account-keeping families with above-average total expenditures exhibited a lower expenditure elasticity for clothing and a smaller downward time trend than the below-average group. A smaller degree of aggregation in the data resulted in a higher estimate of expenditure elasticity and a greater time trend.

Quality changes in clothing were highly associated with time. Also, changes in consumer tastes occurred which permitted economy both in use and production of clothing. However, it was proposed that these factors could not have accounted for the relative decline in expenditures for clothing except that they coincided with a diminished rate of fashion change. The apparent time trend in clothing expenditures during 1929-1958 might have been due to two brief periods of extensive fashion change.

It was believed that a model describing clothing expenditures during the years 1929-1958 should include an index of fashion change, because of the semi-durable characteristics of clothing and consumer willingness to discard wearable clothing in periods of fashion change.

Microfilm \$2.60; Xerox \$9.00. 200 pages.

ECONOMICS, AGRICULTURAL

ESTIMATION OF BROILER OUTPUT  
AND PRICE: A SHORT RUN  
PREDICTIVE ANALYSIS.

(L. C. Card No. Mic 60-5227)

Raymond O'Connor Paul Farrish, Ph.D.  
The University of Connecticut, 1960

This study is concerned with the short run (three months) prediction of United States broiler output and price. The major objectives of the study are:

- to estimate supply and demand parameters for broiler meat.
- to predict broiler output and price for time periods other than those from which parameters were estimated.
- to evaluate predictions made by comparison of predicted and actual outputs and prices.

The study covered the 1948-59 period, with supply and demand parameters estimated from 1948-56 data used to predict 1957-59 output and price.

Significant shifts in the level of demand for broiler meat were found between winter and summer periods, although significant seasonal variation was not found in price, income and cross elasticities of demand. Variables included in the demand functions were broiler price, red meat price, per capita disposable income, and per capita consumption of broiler meat.

Several supply models for broiler meat were developed, with attention centered on relations between output and previous returns within the industry. The model selected for prediction purposes related output in period  $t$  to returns in period  $t-1$ , returns in period  $t-4$ , and productive

capacity of the industry at the start of period  $t-1$ . Output of broiler meat was found to vary directly with lagged profits and capacity.

The estimated supply and demand parameters were utilized to predict broiler output and price for the 1957-59 period. Eighty percent and seventy-five percent of price and output predictions, respectively, were found to agree in direction of change with actual output and price movements. Errors of price prediction were concentrated in the latter part of the 1957-59 period. Errors of output prediction were primarily in fourth quarters, with output generally overestimated. The value of the predictive model was discussed in terms of costs which would be involved if production decisions were based on predictions made. Only one error of price prediction would have involved any substantial cost.

Results of the analysis gave promise that useful predictive models can be developed. Suggestions were made for future refinement of the research reported, including the suggestion that structural parameters be reestimated before each new prediction.

Microfilm \$2.50; Xerox \$5.40. 110 pages.

#### THE IMPACT OF POOLING ARRANGEMENTS ON MILK PLANTS AND PRODUCERS IN EASTERN PENNSYLVANIA

(L. C. Card No. Mic 60-5436)

Paul Edgar Hand, Ph.D.

The Pennsylvania State University, 1960

Dairy farmers in eastern Pennsylvania ship milk to the New York-New Jersey marketing area regulated by Federal Marketing Order Number 27 with a market-wide pool, to the Philadelphia marketing area regulated jointly by Federal Marketing Order Number 61 and the Pennsylvania Milk Control Commission, with individual-handler pools, and to numerous secondary markets in Pennsylvania, regulated by the Pennsylvania Milk Control Commission, with individual-handler pools. In those areas where the three market outlets are in competition for milk supplies, secondary markets tend to pay the highest blend prices to producers, Philadelphia Order 61 plants the next to the highest and New York-New Jersey Order 27 plants tend to pay the lowest blend prices of the three groups. In recent years, a relatively greater proportion of the increased production in Pennsylvania has been going to Order 27 plants than to other Pennsylvania markets, including Philadelphia; and a relatively greater proportion of the increased supply has been going to the Philadelphia market than to the remaining Pennsylvania markets.

The purpose of this study was to analyze the effects of classified pricing and pooling arrangements on different types of milk plants and the subsequent effect on producers with alternative outlets. Since most of the milk added to the large markets was from producers located in the present production area, the characteristics of producers were analyzed to determine if the differing regulatory provisions were resulting in differentiated groups of producers.

It was hypothesized that under individual-handler pooling, dealers with relatively high fluid utilizations were

able to select producers who met desired standards of seasonality, volume, quality and other characteristics. In addition, these plants would not add volumes of milk unless fluid sales increased. Under market-wide pooling, utilization was blended across the market and all producers received the same base price. Thus, market-pool plants would be inclined to solicit producers to increase volume and would be less particular about the characteristics of producers who were added. The primary reason for producers changing to individual-handler plants would be to get a higher blend price. On the other hand, the main reason for shifting to market-pool plants would be involuntary as the result of being forced out of a market by the decision of a plant operator.

The economic characteristics of different types of milk plants were analyzed. Manufacturing plants tended to become associated with the market-wide pool where payments were made to such plants from the producer settlement fund. In addition, if numerous manufacturing plants were associated with the market, it was difficult to determine a proper price for milk in manufacturing uses, due to the different volumes handled. As manufacturing plants bid for producers, in an attempt to increase volume, price level for all milk tended to increase. Fluid plants, on the other hand, were interested in regulating intake to fluid sales by discouraging production or by adjusting producer numbers.

A sample of producers who had shifted between plants under different types of pooling arrangements from 1952-56 was interviewed. Producers who had not changed plants during 1952-56 were interviewed as a check group. Variance analysis and multiple correlation techniques were used to analyze the producer sample.

Pooling arrangements had a pronounced effect on producer characteristics. Outstanding features of the individual-handler pool were the different prices among plants and the fact that producer returns were higher at individual-handler plants than at market-pool plants. These price differences gave larger and more progressive producers an opportunity to obtain higher blend prices by shifting dealers.

In this highly regulated industry, the individual-handler pool provides an incentive for producers to produce milk which meets fluid requirements and needs of the market. The market-wide pool provides an outlet for all milk produced with little regard for the needs of a fluid market. Since producer returns were relatively higher under individual-handler pools, this system provided an economic reward for producers who met the requirements of a fluid milk dealer. Microfilm \$2.50; Xerox \$7.40. 158 pages.

#### POULTRY SUPPLY FUNCTIONS

(L. C. Card No. Mic 60-5880)

Yujiro Hayami, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: Earl O. Heady

This study is concerned with the supply analysis of poultry products at the farm level on the basis of nationally aggregated time series data. A knowledge of both demand



and supply is required for adequate understanding of price mechanisms in the market. Yet the information we have about the supply of agricultural products is much less sufficient for the purpose of prediction than that of demand.

One of the basic causes of this unbalanced knowledge in these two fields is the difficulty in formulating for quantitative analysis the variables which affect supply, such as technology, quality of human input and farmers' expectations. Changes in these variables are qualitative by nature, and it is difficult to set up quantitative relations between these variables and supply. However, in the supply analysis of poultry products, it is essential to incorporate technology as a variable because poultry production is characterized by the rapid progress of technology with the resulting increases in total output. Hence the primary emphasis of this study is placed on the inclusion of technology in the poultry supply analysis.

As a first step an attempt is made to quantify the technology of poultry production. The number of eggs per layer, the broiler-feed conversion rate and the turkey-feed conversion rate are selected as the output-input ratios or average productivities which indicate the levels of technology in the production of eggs, broilers and turkeys, respectively. In order to extract the net change in technology from the data of these output-input ratios by eliminating the effects of such factors as market situation, the logistic function is fitted to the data. The values obtained from the estimated logistic functions are called, respectively, the technology index of egg production, broiler production and turkey production.

Supply models are constructed for (1) eggs and farm chickens, (2) broilers and (3) turkeys with these technology indices incorporated. Besides the standard linear equation models, the models of a non-linear price coefficient are included in order to evaluate the effect of technological progress on the price elasticity of supply.

As a basic method of estimation the single equation least-squares is used for its simplicity and predictive ability. The simultaneous equation approach is restricted to the case of broiler supply in which the simultaneous determination of price and output is so great as to cause appreciable bias in the least-square estimates.

It is shown through the empirical analysis that improvements are created by using the technology index instead of the time trend in the estimation of poultry supply model, and the effects of technological progress on the price elasticity of poultry supply are estimated in a quantitative term. On the other hand, appreciable defects of estimation, which are likely caused by neglecting such factors as farmers' future expectation and quality of human input, are found in this analysis. Efforts must be made to further incorporate these factors together with technology into supply analysis in order to attain the final goal of meaningful supply study.

Microfilm \$2.50; Xerox \$8.60. 187 pages.

## RESOURCE PRODUCTIVITY ESTIMATES FOR FIVE TYPES OF PHILIPPINE FARMS

(L. C. Card No. Mic 60-6126)

Emilio U. Quintana, Ph.D.  
Purdue University, 1960

Major Professor: D. Woods Thomas

This study has been an attempt to provide an empirical base for decisions relative to possible governmental action programs affecting resource allocation, efficiency and agricultural output of five types of Philippine farms and to provide a set of guides to these farmers relative to the kind and magnitude of adjustments in resource allocation which might be required to increase economic efficiency, income and farm output.

The specific objectives of this study were: to statistically estimate production functions and derive marginal value products for each of several input categories used in production on five types of Philippine farms in 1956-57, to determine optimum combinations of resources for a given level of production under given factor-factor price relationships and to compare marginal value productivities of these several resource categories as a basis for indicating the economic desirability of possible re-allocation of resources among and within the five types of farms.

This study was concerned with rice, corn, tobacco, abaca and coffee farms in the Philippines. A probability sample of farms was drawn from each of these strata. These samples consisted of 62 rice farms, 59 corn farms, 60 tobacco farms, 60 abaca farms and 50 coffee farms. Data were obtained by personal interview of the farm operator.

Cobb-Douglas type production functions were fitted to each set of input-output data. The least squares regression technique was used.

Rice, tobacco and coffee farms were characterized by decreasing returns to scale. Abaca farms had almost constant returns to scale. Increasing returns to scale existed among corn farms.

In each case, reasonably good statistical fit were obtained. This is indicated by the following coefficients of determination ( $R^2$ ) each of which was statistically different from zero at the one per cent level of significance.

	$R^2$
Rice farms (Equation II):	.65
Corn farms (Equation II):	.75
Tobacco farms:	.60
Abaca farms:	.75
Coffee farms:	.64

The productivity of the several input categories varies widely from one Philippine farm type to another. On abaca and tobacco farms, too much land was being employed relative to the other inputs. On the other hand, too little land was being employed on coffee, rice and corn farms. Marginal value products of man labor were higher than their marginal factor costs on abaca and tobacco farms. These findings indicate that on rice, corn and coffee farms, too much man labor was being employed whereas on abaca and tobacco farms too little man labor was used. The estimated marginal value products of the man-animal labor indicate that this input should be reduced on corn, tobacco and coffee farms. On the other hand, this input should be increased on rice farms. Machinery, tools and equipment

did not influence output on four out of five Philippine farm types studied. The only farm type where machinery, tools and equipment appeared to be significant at the one per cent level was on abaca. The marginal value product of current operating expense was high relative to marginal factor cost on all farm types studied. If the marginal factor cost of current operating expenses at 1.06 is taken as the appropriate decision criteria, then this input was not used efficiently in each of the five types of farms studied. If adjustments are to be made, economic gains are likely to be greatest when current operating expenses are increased on abaca, corn and tobacco farms. Marginal value products of current operating expenses were also high on rice and coffee farms but were closer to the equilibrium point than those of the three other farm types studied.

The findings of this study provided evidence of inefficiency of the current resource allocation. Although adjustments are economically desirable, inherent conditions of the individual farm types studied, such as low labor mobility, lack of capital and limited supply of land in the areas hinder the implementation of these adjustments.

Microfilm \$2.65; Xerox \$9.25. 204 pages.

#### MARKET PERFORMANCE IN THE PERISHABLE BAKERY PRODUCTS INDUSTRY

(L. C. Card No. Mic 60-6133)

David Alden Storey, Ph.D.  
Purdue University, 1960

Major Professor: Paul L. Farris

The objective of this study was to evaluate market performance and factors that affect market performance in the perishable bakery products industry. This industry includes industrial producers of bread, rolls, cake, pie, doughnuts, sweet goods and other perishable bakery items, and is subdivided into the wholesale, home service, grocery chain and multi-unit retail baking industries. Attention was focused on the wholesale baker-retail grocer marketing channel during the post World War II period, with particular emphasis on distribution problems. The distribution costs of wholesale bakers increased considerably during the period of this study, primarily because of the kinds of distribution practices they followed. Grocery chain stores employed different distribution practices and chain distribution costs were correspondingly lower.

An introductory framework set forth strategic dimensions of market performance and aspects of structure and conduct that affect performance. Marketing processes, the consumption of bakery products, the organization of the baking and retail grocery industries and price and cost patterns in the baking industry were presented. Labor productivity was evaluated as a partial measure of technological progress. Analyses were based primarily on secondary data, supplemented by interviews with baking industry officials and observations of baking industry practices. Aspects of market structure, conduct and performance were evaluated, drawing on findings from preceding sections.

It was concluded that there were considerable imperfections in the market performance of the wholesale baking industry. Excess profits were above the national average, and bread price increases were greater than general price level increases. These factors along with relatively infrequent price changes indicated lack of price response to shifts in demand and cost. A large amount of resources were devoted to sales promotion, much of which appeared wasteful from a social viewpoint. There was excess capacity in many plants, and the average plant appeared smaller than the optimum scale. Although product choice appeared adequate, product development was initiated mostly by non-baking firms. Slow technological progress was indicated by a slow rate of increase in labor productivity and an apparent scarcity of innovations.

Product perishability and bulkiness caused local market areas to be small relative to optimum wholesale baking firm size. The large optimum firm size and the difficulty of getting outlets for sales of products created barriers to entry. These factors led to fairly high concentration in local market areas, which was associated with undesirable market performance. The relatively large increase in bread prices reflected logical revenue maximizing behavior when demand is inelastic (which is strongly believed to be true for bread) and firms have market power to set prices and control output.

Recent changes in structure have had important effects. Both the baking and retail grocery industries are becoming more concentrated. Where retail grocers manufacture or contract for private label products, greater productive efficiency, technological progress, less sales promotion and relatively lower selling prices have occurred in affected markets. The resulting struggle for remaining outlets by wholesale bakers has increased their sales promotion costs. Important problems immediately facing the baking industry include finding ways of reducing distribution costs and reducing product perishability.

It appears socially desirable that bakery firms should get larger in order that advantages of larger units in production and distribution will be possible. Structural changes may then be made which will result in less costly distribution methods, will bring pressure on prices and will motivate more rapid technological progress. Such changes appear likely to be initiated by pressure from the grocery chain industry and industries in direct competition with the baking industry, such as the frozen foods industry.

Microfilm \$2.90; Xerox \$10.15. 224 pages.

#### FACTORS AFFECTING INDUSTRIAL LOCATION IN SOUTHERN INDIANA

(L. C. Card No. Mic 60-6139)

Luther Tompkins Wallace, Jr., Ph.D.  
Purdue University, 1960

Major Professor: Vernon W. Ruttan

The objectives of this study were (1) to develop an approach to industrial location which included consideration of the role of the community as a location influence, (2) to test hypotheses relative to this approach with data obtained in an empirical investigation of industrial plants



which located in southern Indiana (the southern third of the state) during the period 1955-1958, and (3) to identify the specific factors most influential in the location decision of these plants.

To accomplish the first objective, a model was constructed which defined the relationships between (1) the autonomous and volitional forces operative within a community, (2) the economic, non-economic, and bargaining factors potentially involved in a plant location decision, and (3) the geographic areas and sub-areas involved in the site selection.

To complete the second objective, hypotheses were tested with respect to (1) location factors and the autonomous and volitional forces operative within the community, (2) the influence of economic, non-economic, and bargaining factors on the site selection of different kinds and sizes of industrial plants, and (3) the influence of geographic areas in the site selection process, including the relative industrial development potential of smaller rural communities as compared to larger more urbanized communities. Data to test these hypotheses were obtained from 72 plant managers of the 82 plants which located in southern Indiana during the time period studied. Of these 72 plants, 58 had initiated production schedules by December 1958. There were 4,548 manufacturing jobs created in the area by these plants, only 432 (9.3 percent) of which were filled with imported skilled labor. Forty-four (61.1 percent) of the 72 plants were branch plants or subsidiaries.

With respect to the third objective, the four most important influences on plant location indicated by the managers of industrial plants locating in southern Indiana during 1955-1958, were: (1) availability of labor, (2) adequacy of transport, (3) proximity to both local and regional producer's goods and consumer's goods markets, and (4) availability of local and regional raw material sources. However, the survey showed wide variation in the needs of plants and managerial response to alternative sites. The extreme individuality of the site selection of each plant almost makes each location decision a case study in itself. Different factors in different communities have varying influences and degrees of effectiveness on the location of a plant. For this reason, it is extremely difficult to predict the success of a community's industrialization efforts with a particular plant even though broad generalizations can be made relative to factors affecting plant location.

The tests of hypotheses indicated that:

- (1) Economic and non-economic factors affecting the location decision were derived from general as well as local autonomous and volitional forces. Also, recognition of the community as a volitional force led to the emergence of bargaining factors which were capable of differentiating communities, in the judgment of management, by influencing the plant's site costs.
- (2) The relative importance of economic and non-economic factors, including those under volitional community control, varied mainly with plant size. The smaller the plant the more it was interested in obtaining advantages from the community. However, in almost all cases, economic factors were a greater influence on the location decision than non-economic factors.

- (3) Management did consider the regional, specific area, and site aspects of plant location, particularly if the plant were a branch plant or subsidiary. However, the three stages were seldom clearly defined. The number of location factors, and the relative influence of autonomous and volitional forces varied in each of the three geographic stages, i.e., the region contained a greater number of factors subject to autonomous forces than did the site.

And finally, in southern Indiana, potential for industrial employment growth did not vary directly with community size during 1955-1958. Communities under 5,000 population gained more manufacturing jobs, relatively and absolutely, than did communities with population 10,000 and over. This finding implied that during the period studied rural communities were less limited in their industrial development than urban population centers in the area. However, even though the majority of industrial development did occur in relatively small communities, these communities were (1) located in the more heavily populated counties, and (2) these counties were located within the flow of the area's mainstreams of commerce and trade.

Microfilm \$3.40; Xerox \$11.95. 262 pages.

#### ECONOMIC ANALYSIS OF THE USE OF NITROGEN FERTILIZER ON FORAGE CROPS IN PENNSYLVANIA

(L. C. Card No. Mic 60-5466)

Eldon E. Weeks, Ph.D.

The Pennsylvania State University, 1960

#### The Problem

Past agronomic recommendations for forage use of land have generally been to grow legume-grass mixtures, the legume plants contributing directly to forage yield and at the same time providing nitrogen to promote growth of the associated grass. However, commercial nitrogen fertilizers can be used to promote the growth of grass. Many grasses are adaptable and will survive for a long time over a wide range of physical conditions compared to some of the higher yielding legumes.

Awareness that nitrogen fertilized grasses might be feasible substitutes for legumes has grown out of pronounced improvements in forage handling machinery, forage handling methods, labor saving methods of handling livestock, and increased insect and disease hazard in legumes. These changes have tended to direct emphasis in Pennsylvania agriculture to the production of forages and away from grain crops.

This study is concerned with the general problem area that relates to farmers' decisions whether and under what conditions the use of nitrogen fertilized grass is to be included in their farm operations.

#### Procedure

The seven farms selected to be studied are believed to represent conditions commonly found on Pennsylvania farms with respect to land and other such characteristics

as availability of markets, size of farm, crop and livestock enterprise choices, and production technology.

The same livestock enterprises were used for all farms in the study. Land use enterprises were developed for land classes and geographical areas previously discussed. Farm practices generally were those recommended in light of current knowledge. Productivity of crops and animals was believed obtainable by farmers if currently recommended farm practices were employed. These practices and productivity estimates were obtained from secondary sources and from recommendation of consulting subject matter specialists. Prices used were those current in 1958 and 1959.

A linear programming model was formulated for each farm. This was solved at two prices of nitrogen --- 6 and 16 cents per pound. These solutions were manipulated to obtain answers to questions concerned with changes in "net" farm revenues and farm organization such as effects of changing the price of nitrogen within the range of 6 to 16 cents per pound, given farm organizations, breakeven yields of orchardgrass hay, "permanent" forage organization of cropland, and replacement of purchased hay with grain as livestock feed.

#### Conclusions

Increasing the price of nitrogen from 6 to 16 cents per pound did not cause differences in income greater than \$6.00 per acre on the farms used in this study. Considering the possibility of errors in the data used, these differences are not large. Without prospect of large expected changes in incomes, farmers might hesitate to change cropping programs in response to changes in nitrogen price.

For the farms studied, changes in income between optimum and "permanent" forage programs are not large. Neither are changes within "permanent" forage programs large as price of nitrogen is changed from 6 to 16 cents per pound. In view of these, neither prospective revenue gains or losses appear large enough to make farmers' plans sensitive to small changes in nitrogen price (nitrogen prices between 6 and 16 cents per pound).

All farms in this study purchased hay. Replacement of this hay with purchased grain cost very little (not more than \$1.50 per acre) in terms of "net" farm revenue. Thus the results of this study do not depend upon reliance on hay markets for purchased feed.

Breakeven yields of grass hay with most efficient legume hay competitors were calculated. These tended to support previous analyses and conclusions. Also, they tended to be uniform within region and land class.

Microfilm \$2.50; Xerox \$6.20. 128 pages.

#### RESOURCE ALLOCATION FOR DAIRY AND FIELD CROPS IN THE NEGEV AREA OF ISRAEL

(L. C. Card No. Mic 60-5896)

Dan Yaron, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: Dr. E. O. Heady

The study is concerned with optimal allocation of resources on newly developed family farms in the Negev area of Israel. The dominant type of family farming in Israel is a small, input-intensive mixed farm based mainly upon dairy husbandry. Further development of the dairy industry is likely to lead to a surplus of milk. To prevent this situation a new type of farming based mainly on field crop production was introduced into the new settlement projects. The main concern of this study is the question whether or not the field crop farming may provide an economically sound substitute for the conventional dairy farming.

The first part of the study is positive and concentrates on production function analysis of two 1957 samples of newly established dairy and field crop farms. The empirical analysis shows that while in both types divergencies between the marginal value products of the resources and corresponding market prices have been observed in either direction, no significant difference has been found between the productivity of the same resources on the two types. The latter result suggests that no one type should be preferred to another in the short run, while influx of additional resources to the farms is considered. A new approach towards estimating the managerial input through factorial analysis in relation to the production function is developed.

Comparison of the resources of the farms and their incomes shows no difference between the types. However the inference derived from the positive part of the study is relevant for short run policy decisions only due to the low level of the development of the farms at present.

The second part of the study is normative and considers the two types in their optimal development. Optimal plans have been worked out for the two types by linear programming techniques. These plans show that under 1957 price structure and technology the dairy farming will be significantly more profitable than the field crop farming.

Applying variable-prices and variable-resources linear programming methods the conditions for economic coexistence of field crop and dairy farming are shown to be obtained either by:

- (a) A considerable fall in the price of milk.
- (b) Considerable subsidies on the prices of field crop products competitive with milk.
- (c) A fall in the price of milk supplemented by increasing the scale of the farms in the order to maintain a proper level of income.
- (d) Various combinations of (a) through (c).
- (e) Physical production controls.

Quantitative estimates of (a) through (c) are derived.

Analysis of the policy measures towards (a) through (e) suggests that none of them seems to be easily acceptable. The conclusions of the study with respect to the long



run agricultural policy suggest that alternatives other than field crop production should be sought with the goal of expansion non-dairy, labor and/or capital intensive farm industries.

Some of the products considered confront negatively sloping demand curves as the region concerned is a major producer of these products. A new approach to non-linear programming with separable objective functions is developed to include these products in programming. The approach is based on stepwise approximations to the marginal net revenue functions of the products with downward sloping demand curves. This procedure modifies the problem to one (a) equivalent to the marginal allocation problem known from the basic economic theory, and (b) easily solvable by the simplex method.

Microfilm \$2.95; Xerox \$10.35. 227 pages.

## ECONOMICS, COMMERCE - BUSINESS

### PROBLEMS RELATING TO THE CERTIFIED PUBLIC ACCOUNTANT'S OPINION ON FINANCIAL STATEMENTS

(L. C. Card No. Mic 60-5640)

Warren Glenn Berg, Ph.D.  
State University of Iowa, 1960

Co-Chairmen: Professors Gilbert P. Maynard and  
Daniel L. Sweeney

This study was undertaken for the purpose of determining the interpretation, by the laity, of the certified public accountant's normal audit leading to a written opinion of the financial statements, and if misinterpretations exist, to determine their various effects and to suggest corrective measures if needed. Are there differences between what a C.P.A. does and says through the conduct of an audit and the writing of his opinion, and what interested parties believe him to be doing and saying? Particularly, the author was interested in the element of fraud detection.

The subject is important because there has been a gradual change in the size and complexity of business organizations, with a corresponding change in the characteristics of audit methodology. The latter change has removed fraud detection from the position of a primary audit objective to the position of merely a possible by-product. The C.P.A.'s increased reliance upon the internal control and internal auditing of the company under audit, coupled with the use of tests and samples rather than a detailed examination, has increased the chance for a fraud to go undetected in the audit. This has caused a corresponding increase in the chance for litigation involving the auditor and his client or an interested third party.

The early chapters trace the historical development of the profession and professional activities and describe the legal and ethical framework within which the auditor must confine his activities. Next, the misinterpretations of the audit and its objectives, within as well as without the public accounting profession, are described. The ambiguities of professional pronouncements on the subject,

together with the conflicting writings in the professional journals, are indicated. These ambiguities are then examined within the framework of the C.P.A.'s legal and social responsibilities.

In developing his conclusions, the author has divided frauds into two groups--those in which an attempt has been made to conceal a defalcation through the manipulation of income statement accounts, and those in which the concealment is through the manipulation of balance sheet accounts. It is shown that there is likelihood that the latter manipulation will be discovered during the normal audit but that the likelihood of discovery of the first type is greatly reduced. In addition, frauds involving a labyrinth of management collusion will likely not be detected.

The situation presents litigational dangers for the individual practitioner as well as the danger that the independence of the members of the profession will be restricted through legislative action or the action of regulatory agencies.

The author's conclusions involve a suggested three-fold program of education. He advocates a change in the wording of the short form report so that the C.P.A.'s opinion is given only on the fairness of the company's presentation of its position and the net results of operations. In addition, the report should include a definite statement vesting authorship of the statements in the management of the client-company. The author urges the use of a formal written contract for each engagement, specifically exempting the auditor from responsibility for fraud detection. He advocates the revision of the generally accepted auditing standards toward the clarification of the auditor's responsibility for fraud detection. The latter revisions include the clarification of the required evaluation of internal control as well as changes placing a limitation on fraud responsibility.

Microfilm \$3.65; Xerox \$12.85. 282 pages.

## PRINCIPLES OF ACCOUNTING SYSTEMS DESIGN

(L. C. Card No. Mic 60-4536)

James Beardsley Bower, Ph.D.  
The University of Texas, 1960

Supervisor: Dr. Charles T. Zlatkovich

The existence of "principles of accounting" is an accepted fact in accounting literature. Accounting postulates are derived from experience and reason, prove to be useful, and become accepted as "principles of accounting," and in some instances, as "generally accepted principles of accounting." This dissertation identifies and verbalizes a series of postulates thought to be "principles of accounting system design." These postulates were derived in the same manner as accounting postulates, from experience and reason, and are interpreted, validated, and ranked according to their relative impact and importance.

Eight postulates with supporting statements were organized into a lengthy questionnaire and submitted to 191 accounting system experts for acceptance or rejection, evaluation, and ranking. Experts were affiliated with companies or firms representative of the following:

Multiple Office CPA  
Single Office CPA  
Business Equipment or Forms  
Manufacturing  
Distribution  
Service or Financial  
Regulated or Governmental  
Educator

Replies received from 137 experts formed the basis for ranking seven of the postulates as "generally accepted" principles of accounting system design. In the order of their relative impact and importance, "generally accepted" principles are as follows:

1. Reasonable Cost: The accounting system should be designed to provide information and control, consistent with the needs of management, at a reasonable cost.
2. Report: The accounting system should be designed to permit effective reporting, both internally and externally.
3. Internal Check: The accounting system should be designed to safeguard assets and prevent fraud or other irregularities.
4. Organization Structure: The accounting system should be designed to function in a specific, clearly defined, organization structure.
5. Reliability: The accounting system should be designed to check the reliability and accuracy of accounting data.
6. Flexible and Uniform: The accounting system should be designed to be flexible, yet insure reasonable uniformity and consistency of application.
7. Audit Trail: The accounting system should be designed to facilitate retracing of procedural steps and to permit the analysis of detail underlying summarized information.

The eighth postulate is a "principle of accounting," but is not yet "generally accepted."

8. Least Common Denominator: The accounting system should be designed so that information normally is not combined in the initial recording or summarizing which will later have to be separated.

The eighth principle is narrow, and a broad "Data Accumulation" postulate may be more appropriate, and may eventually become "generally accepted." A "Data Accumulation" postulate is as follows:

Data Accumulation: The accounting system should be designed to enable the rapid and efficient classification and grouping of accounting data into the desired categories for planning, controlling and the accomplishment of administrative routine.

Two "generally accepted" principles are extremely broad. Evidence indicates that two additional postulates could be verbalized from the broader principles without altering their validity. A "Human Factors" postulate can be derived from the "Organization Structure" principle as follows:

Human Factors: The accounting system should be designed consistent with applicable human factors.

A "Data Processing" postulate can be derived from the "Reliability" principle as follows:

Data Processing: The accounting system should be designed to include an efficient and effective processing system for accounting data.

Supporting statements were suggested to accounting system experts for each of the eight principles. Experts evaluated the statements for validity and extent of support to the applicable principle. The extent of acceptance for each supporting statement is helpful in providing a description of the subject area covered by each principle.

Microfilm \$7.45; Xerox \$26.55. 586 pages.

#### THE EFFECTS OF THE FORMATION OF THE EUROPEAN ECONOMIC COMMUNITY ON MANAGERIAL DECISIONS OF ENTREPRENEURS IN MEMBER COUNTRIES

(L. C. Card No. Mic 60-5131)

Harald Einsmann, Ph.D.  
The University of Florida, 1960

At the beginning of the study the ideological, historical, and politico-economic developments which led to the emergence of the European Economic Community (EEC) were discussed.

The economic structures of the member countries (Belgium, France, Germany, Italy, Luxembourg, and the Netherlands) were examined and the advantages and burdens which will arise from the formation of the EEC were summarized.

An attempt was made to predict the impacts and effects which will result from the transforming of the present economic situation by the forces set in motion by the Treaty. It was found that economic integration will influence total economic welfare in three ways. It will change the economic behavior of consumers and production methods used by producers, it will bring about a reallocation of production, and finally it will change the volume and nature of investment. It was also found that economic integration may be expected to result in increased competition, increased exploitation of economies of scale, increased international specialization of labor, and an accelerated over-all growth of the economy.

The general findings enumerated above were confirmed by a study of three individual industries in the Common Market, the road motor vehicle industry, the electrical engineering industry, and the cotton industry.

The study was concluded by expressing the expectation that in Europe, through economic integration, social, cultural, and even political contrasts are likely to diminish and that Europe itself has built a chance to put its dream of the United States of Europe into reality.

Microfilm \$3.95; Xerox \$13.95. 308 pages.



# FEDERAL INCOME TAXATION AND THE CORPORATE EXECUTIVE

(L. C. Card No. Mic 60-4545)

William Henry Hoffman, Jr., Ph.D.  
The University of Texas, 1960

Supervisor: Dr. C. Aubrey Smith

The Federal income tax, above all other forms of taxation, has been the subject of immeasurable public censure and abuse. But since criticizing the tax structure has been an activity that man has relished from the very first time the complexities of organized life necessitated assessments for the good of a society, any denunciation of taxes might conceivably be categorized as a normal manifestation of human nature. Unfortunately, distressing signs are currently available which would indicate that the progressive income tax has revealed marked inherent deficiencies that threaten the very acceptability of the levy to the average taxpayer.

The basic problem, then, in any study of Federal income taxation must consider whether or not the law is as objectionable in its present form as many would have us believe. Due to the great breadth and extensive complexity of modern tax law, an evaluation of its adequacies might well prove more meaningful and feasible of accomplishment if restricted to a limited segment of the whole. Thus, the corporate executive is chosen as the subject of investigation, among other reasons, as the most efficacious means to an end.

Tax research, to offer a full measure of return, should not be divorced from the every day exigencies of tax practice. Consequently, any appraisal of the tax status of the corporate executive would hardly create much interest unless it could be geared to enabling the taxpayer fully to adjust his lot in life to a legitimate minimization of tax liability under existing law. It is believed that narrowing the schism between tax research and tax practice by combining the two approaches within a single work may lead towards a better understanding of the problems involved and aid in arriving at a workable solution for the ills of the Internal Revenue Code.

The modern corporate executive will generally find that his status under the Federal income tax law is characterized by a high degree of flexibility. Though the basic salary paid to a top level employee may be subject to the full severity of the progressive rate scale, ingenious compensatory devices which can offer substantial amounts of tax sheltered income are not infrequently available. When properly situated, then, the corporate executive possesses an enviable station in life that compares favorably to the tax position of many other preferred taxpayer groups.

All corporate executives are not fortunate enough to enjoy equally the benefits allowed under the tax law. Because of cost considerations, the attitude of employers, the competitive position of the employee, or even the overt discrimination in application effected by the Code or Internal Revenue Service, many executives find that they are unable to qualify for the tax preferences that are so commonly assumed to be open to them. Thus executive compensation immediately reveals the violation of a cardinal precept of equitable tax jurisprudence: that taxpayers of equal circumstances and similarly situated should suffer equal tax liabilities.

In summary, this study sets out to prove, by the medium of the corporate executive, that the Federal income tax is in dire need of substantial revision. During the course of this process, extensive treatment is accorded to effective tax planning procedures, in order to emphasize the extreme complexity that is bred by the present system of preferential treatment and to attach practical significance to the investigation conducted.

Microfilm \$5.00; Xerox \$17.80. 392 pages.

# AN ANALYSIS OF CLASSIFIED ADVERTISING IN NEWSPAPERS

(L. C. Card No. Mic 60-4844)

J. D. Landes, Ph.D.  
The University of North Carolina, 1960

Supervisor: Charles A. Kirkpatrick

The purpose of this study is to analyze classified advertising in newspapers and to arrive at conclusions regarding its effectiveness and its future. The analysis is based on the operations of fifty-six newspapers with circulation figures ranging from 20,000 daily copies to 936,000. Included are a brief history of newspaper advertising, reviews and analyses of advertisement classifications, copy and typography technicalities, classified advertising rate structures, and managerial and financial matters. Emphasis is given to the growing importance of newspaper classified advertising, not only as a means of rendering a public service but as a significant source of revenue to the publisher.

The findings suggest the following conclusions:

(1) Despite periodic declines in volume, the long-run growth in newspaper classified advertising lineage justifies an optimistic outlook for this form of advertising.

(2) Advertising volume will grow in accordance with the ability of the service to get results for the advertiser.

(3) One of the big problems of the newspaper industry is to educate people, both readers and advertisers, to the advantage and uses of classified advertising.

(4) The ever-present problem of rising rates is causing increasing concern. Although the publisher sets rates on the basis of what he feels the traffic will bear, it is the advertiser in the final analysis who determines rate acceptability. No workable formula for rate determination has been devised.

(5) The study revealed the need for a more meaningful indicator of the profit position of a newspaper classified advertising department. There appears to be a special need for more equitable means of allocating production costs to the revenue-producing departments. The total paper content method is a step in the right direction.

(6) There are still many newspapers with undeveloped classified advertising services. Some publishers continue to look upon the "want ad" operation as a necessary evil, a public service which they are obligated to render and have apparently failed to recognize its potential as a circulation builder and source of revenue.

Microfilm \$2.50; Xerox \$8.40. 182 pages.

# THE DEVELOPMENT OF PHILOSOPHIES OF PERSONNEL ADMINISTRATION

(L. C. Card No. Mic 60-4848)

Charles Rudolph Milton, Ph.D.  
The University of North Carolina, 1960

Supervisor: Harry D. Wolf

The purpose of this study was to give a historical perspective of philosophies of personnel administration in America and the key concepts contained therein. Factors comprising the framework of investigation were the concept of labor held by employers, the inclusion or omission of tenets for an adequate philosophy, the utilization of contributions from the social sciences, the type of leadership demonstrated, and the consistency of personnel philosophy with public, community, and employee values. In tracing this chronological development, the economic, social, and political developments and advances in the social sciences that stimulated changes in personnel philosophy were examined.

Personnel philosophy was sought in the personal comments and writings of industrial executives as found in managerial publications. The development and utilization of personnel administration as a function, or department, of general management provided the main evidence of the extent to which expressed philosophy was implemented by concrete action. In addition the anticipated future trends in personnel philosophy and function were noted.

During the nineteenth century, when the nation became industrialized, a laissez-faire rationale of personnel became dominant. This philosophy was extremely individualistic, materialistic, devoid of consideration for human values, and complemented by autocratic principles of management. Labor was deemed a commodity or a machine.

After the turn of the twentieth century an authoritarian philosophy of personnel administration became prominent. The authoritarian philosophy differed from the laissez-faire philosophy in that the human factor was given more consideration; exploitation was no longer considered an appropriate managerial practice, and employees were viewed as unique and a natural resource to be efficiently utilized rather than as a commodity or machine.

The authoritarian philosophy took several forms in welfare management, the do-nothing philosophy, and the technique philosophy. Oriented toward the efficiency aspects of the human factor, none of these philosophies sought to promote employee integrity, self-respect, or dignity within the industrial organization. Scientific knowledge was utilized to manipulate and control for the purpose of achieving greater productivity; and the values of employees, public, and community were generally ignored.

The humanistic philosophy of personnel administration, prevalent among executives today, had its inception in psychology. One of the basic objectives of the humanistic philosophy was the intelligent, planned promotion of the dignity and rights of employees. Psychological and social aspirations are viewed as attainable within the industrial structure, and employee personal development is considered as an ultimate goal. Scientific knowledge is used to implement such objectives rather than for manipulation and control. Labor is viewed as unique, human, and a consumer. The humanistic philosophy considers the values

and sentiments of employees, community, and public and also acknowledges its responsibilities to each group.

A minority of executives have been currently found to have a democratic philosophy of personnel administration which is identical to the humanistic philosophy with the exception that it includes a citizenship concept of labor. Viewed as citizens, employees are entitled to a voice in affairs that affect their welfare. The union may be the institution for achieving this objective, or, if no union exists, the means may be direct consultation and participation by rank-and-file employees.

Businessmen have achieved mastery over physical production and are endeavoring to meet the challenge of promoting human and gratifying personal and interpersonal relationships within industry. Consequently, sound personnel relations are considered not only a requisite condition of efficient and profitable operations, but desirable in the general social interest, and, recently, from an ethical and moral point of view as well.

Microfilm \$3.20; Xerox \$11.85. 248 pages.

## A RECOMMENDED LONG-RANGE PROFESSIONAL EDUCATION PROGRAM IN PUBLIC ACCOUNTING.

(L. C. Card No. Mic 60-4705)

John Bayha Ross, Ph.D.  
University of Alabama, 1960

### Objective and Scope of Study

In recent years some prominent accounting educators and public accounting practitioners have advocated the creation of separate professional programs or schools in public accounting at the post-baccalaureate level. This study was undertaken with the objective of attempting to identify some of the current problems encountered in training for the public accounting profession, and to develop a comprehensive educational program suitable for preparing individuals for professional careers as certified public accountants.

Following the introductory material concerning the growth of the public accounting profession, the study presents a detailed undergraduate curriculum designed to provide a satisfactory foundation for subsequent professional academic studies, and for the demands of professional practice. A separate chapter is then devoted to the problems and methods of selecting qualified students for professional training. Following this presentation, a curriculum for a professional academic program in public accounting is set forth with attention given to the specific content of the courses, teaching methods and materials, qualifications of faculty members, internship training for students, and accreditation problems. Finally, a review is made of the present uniform certified public accountant examination along with the licensing procedures of other professions for the purpose of recommending a suitable examination and licensing system.



### Major Conclusions of Study

From the study it is concluded that within the limited period devoted to professional education, the curriculum of the professional program should be chiefly concerned with providing the factual knowledge, special techniques, and attitudes needed for the practice of public accounting. Conversely, the undergraduate curriculum should function in such a way as to provide students with a broad general education.

All of the professional programs should include advanced studies in certain basic areas such as auditing and taxation, but no attempt should be made by an accrediting body to prescribe a rigid, inflexible curriculum. The teaching methods employed should include not only formal lectures, but also group discussions and the case method of instruction. The proportion in which these methods are used will depend on such factors as the subject matter which is being taught, the number of students in the class, the amount of time to be devoted to the subject, and the availability of authentic cases and other instructional materials from the public accounting profession. At least part of the full-time teaching staff should be composed of individuals who have had extensive, successful careers in public accounting, and who can combine their experience with effective teaching.

A qualifying examination or admission test should not be used as the sole determining factor for admission to the professional academic programs, since the results of a single test series may be inconclusive. Properly used, however, in conjunction with information obtained through letters of recommendation, personal interviews, and an evaluation of the applicant's undergraduate work, an admission test should be quite useful in selecting students who are likely to succeed in the programs and in public accounting practice.

Present statutory incongruities concerning public accounting practice can be eliminated through the enactment of regulatory legislation which eventually restricts practice to certified public accountants, and which provides that all persons seeking to enter the profession as a certified public accountant shall be educated under the same single standard of reasonable academic professional training.

Microfilm \$2.60; Xerox \$9.00. 200 pages.

### HIGHWAY PLANNING AND PRICING

(L. C. Card No. Mic 60-4731)

Paul Weiner, Ph.D.  
Clark University, 1960

Supervisor: Howard W. Nicholson

This paper examines and evaluates recent theories and policies relating to the planning and pricing of highways. Since the thesis of this paper is that the highway system is not being optimally utilized, the main theoretical emphasis and concern is with pricing techniques designed to achieve this objective. However, the empirical study of recent highway policy at the federal, state, and toll road level indicates that the use of price reflected in recent policy decisions bears little relationship to any of the theoretical

pricing objectives. In this empirical study, the historical, deductive, and questionnaire technique were employed as methods of analysis.

The essential theoretical conflict focuses on the potential use of price as a "control" device to achieve optimum utilization of the given plant in the short-run or as an "objective" investment guide. The short-run goal is attained by administrative setting of price equal to short-run marginal costs and differs from the general welfare approach in that social costs due to congestion are included. For this reason, the gap between marginal costs and average costs may be closed. This paper emphasizes the use of short-run marginal costs since there has been a recent tendency to shift from short-run to long-run marginal costs as a "norm" by which to control the demand for public utility services. In the long-run approach, prices serve as a guide to investment by the ability of such prices to recover total costs. The existence of indivisibilities on the production side and congestion on the consumption side make this standard difficult to apply to highways.

What this thesis proposes is the taking of highway investment completely out of the "market" and the use of price to achieve optimum utilization. Such a radical departure from present policy is justified only if: (1) acute shortcomings in present policy exist, and (2) if it is not feasible to correct these shortcomings by having policy adhere more closely to long-run pricing objectives. One deficiency is that present policy does not encourage the best use of the existing plant. In addition, although recent policy decisions reflect aspects of the long-run approach, some questionable investment standards have been developed. There is a departure from the theoretical guide of full-cost recovery in that policy judges the ability to recover full-costs on a basis of planned and arbitrary discrimination. This policy could lead to the "choking off" of demand in certain areas and/or incorrect appraisals of real future needs due to such "distorted" demand.

Careful attention is also paid in this paper to the pricing and planning of toll roads since the pricing objectives of this experience more closely reflects market standards. The widely used example in the federal hearings of the non-feasibility of new toll road expansion as a basis of need for federal participation can be turned around and used to indicate the un-economic nature of large segments of the new federal program.

The conclusion of this paper is that short-run pricing proposals are preferable to both present policy or policies likely to be developed using price as a guide to investment. A number of recommendations are made which include: (1) the separation of the Interstate System into component parts with separate budgets, (2) dropping the "pay-as-you-go" program, and (3) greater administrative flexibility in adjusting tax rates both regionally and seasonally. This implies that the present rate of investment is too high and the direction of investment not optimal. Policies utilizing price variations and controls lead to a better spread of usage and diversion of traffic to other agencies. Doing the most we can with what we have is a desirable pre-requisite to any investment policy.

Microfilm \$3.65; Xerox \$12.85. 283 pages.

## ECONOMICS, FINANCE

THE ECONOMIC EFFECTS OF GOVERNMENTAL  
FISCAL POLICY AS VIEWED BY CERTAIN  
ENGLISH CLASSICAL ECONOMISTS

(L. C. Card No. Mic 60-4821)

Robert Spencer Adden, Ph.D.  
The University of North Carolina, 1960

Supervisor: Dr. Lowell D. Ashby

The purposes of this study are (1) to aid the student who has an interest in the history of fiscal doctrines by viewing the theories and ideas of the English Classical economists in the context of present day theory, and (2) to show where present fiscal theories and policies stand in reference to the Classical doctrines.

This study has been made entirely from library source material and has consisted principally of a study of the original publications of the Classical economists. Included in the study were the works of Smith, Ricardo, and Malthus, as the founders of the English Classical school, and McCulloch, Senior, and John Stuart Mill, as the expositors and generalizers of Classical economics.

In this study the aggregative effects of governmental fiscal policy as viewed by these economists is presented first. Next, a micro-analytical approach is taken in which the writings of these economists are analyzed to show their ideas concerning the effects of certain business taxes. Following this, the Classical ideas concerning public debt are analyzed, primarily in regard to the effects of issuing and repaying debts and the burden of an existing debt. Concomitant with this, their philosophy concerning a balanced budget is explored. The Classical theory of economic growth is also developed, and their ideas concerning the effects of fiscal policy on the growth of an economy are studied. Finally, an over-all evaluation of the contributions of the Classical school to fiscal policy theory is made in terms of objectives that are usually recognized by modern economists as being the most important objectives of fiscal policies.

It has been found that the Classical economists generally did not see the need for, or the possibility of, using fiscal policy as a means of maintaining economic stability. They were primarily interested in the effects of fiscal policy on the allocation of resources, and their writings were largely concerned with the means of transferring resources from private use to public use in an efficient and equitable manner. It was in this regard that they developed their theories of tax incidence. Their fiscal policy recommendations were also geared to encourage the rate of economic growth, which was a prime objective in their view. They were also interested in the shifting aspects of public debt, and their writings reveal important, but somewhat neglected, ideas in this area. While they viewed equality of opportunity as a worthwhile policy objective, they did not believe that it was usually possible to achieve, and they did not extend this to include the equalization of income after taxes. They were more concerned with tax equity than with the promotion of welfare.

A study of the ideas of the Classical economists in this field indicates the degree to which their emphasis upon the proper allocation of resources to public use and the proper distribution of the cost of these resources has given

way to the stabilization objective. A similar perspective on the shifting ideas concerning the public debt is afforded by a study of their position. Modern economists should not neglect these factors. We should not become indifferent to our intellectual past.

Microfilm \$4.55; Xerox \$16.00. 355 pages.

MUNICIPAL DEBT CONTROL  
IN MASSACHUSETTS AND ITS  
COUNTERCYCLICAL IMPLICATIONS

(L. C. Card No. Mic 60-4715)

John Donald Coupe, Ph.D.  
Clark University, 1960

Supervisor: James A. Maxwell

This investigation analyzes the fiscal activities of Massachusetts' municipalities in order to appraise their ability to engage in countercyclical financing and hence aid the federal government in achieving a high level of employment.

The Commonwealth of Massachusetts imposes many financial restrictions on municipal activities including: financial reporting, auditing, a structure of debt restrictions, and a balanced annual budget requirement. The balanced budget requirement forces municipalities to provide funds annually to cover their budgeted expenditures. Assessors must set property tax rates so that the difference between budgeted expenditures and estimated revenues is covered by property tax receipts.

Since recessionary cyclical flexibility in the current account is impossible because planned deficits are illegal, the source of any municipal countercyclical activity lies in its ability to incur debt during recessions. The debt control structure is of central importance in testing the hypothesis that Massachusetts' municipalities can engage in countercyclical finance.

The General Laws of Massachusetts specify purposes for which municipalities may incur debt. Some purposes are inside and others are outside the debt limit which is expressed as a percentage of assessed valuation. The maximum term of the borrowing is specified depending on the type of spending.

The Emergency Finance Board was created in 1933 to supervise laws designed to relieve financial pressures. These laws permitted tax title borrowing, welfare borrowing, and borrowing for projects undertaken in conjunction with the federal government. Specific termination dates were incorporated in these laws. Because the board's effectiveness was recognized, it has been continued and its powers expanded. For example, borrowing for school building and remodeling of public buildings must be approved by the board.

In the postwar period municipalities incurred debt in amounts which pressed on their debt limits. Many municipalities appealed to the General Court for special permission to incur debt. A considerable amount of special legislation was enacted which by-passed the structure of control and placed an inappropriate task upon the General Court. In 1952, the General Court doubled the debt limit and required that all debt incurred above the prior limits



be approved by the Emergency Finance Board. This represented an important extension in the administrative phase of debt control.

The debt control structure gives municipalities some cyclical flexibility. Financing current welfare expenditures by incurring debt is the prime example and this has acted countercyclically. Ability to borrow on the basis of tax title holdings is a potential source of countercyclical finance, but has not been used extensively in recent years. Joint public works ventures of municipalities and the federal government have not assumed importance because there has been only limited federal aid. However, in a prolonged downturn, these could assume great importance.

Minor changes in the debt control structure would greatly enhance municipal countercyclical financing without weakening the structure. The debt limit should be expressed as a percentage of revenue. This is a more realistic approach to debt limitation and by using revenue averaged for a series of years, cyclical flexibility would be built into the structure. Further reliance on the Emergency Finance Board would also lead to greater cyclical flexibility. Changes in restrictions which now require legislative action, such as changes in the appropriation requirement for welfare borrowing eligibility, could be handled more expediently by the Emergency Finance Board in response to economic conditions.

The principal sources used were: the General Laws and the Acts and Resolves of Massachusetts; Municipal Finances, published by the Department of Corporations and Taxation; and the minutes of the Emergency Finance Board which are unpublished, but are available in the State House. Many of the tables presented have been derived from the minutes of the board.

Microfilm \$2.75; Xerox \$9.45. 209 pages.

#### THE LENDING POLICY OF THE EXPORT-IMPORT BANK: A STUDY IN PUBLIC POLICY.

(L. C. Card No. Mic 60-6470)

Robert Reuben Dince, Jr., Ph.D.  
Cornell University, 1960

This study attempts to weigh the effectiveness of the Export-Import Bank as the United States government's official foreign lending agency. A critical analysis of the Bank is developed both from official sources and a study of internal loan memoranda prepared by the Bank's staff.

Large-scale portfolio lending by the United States ended at the beginning of the Great Depression, and the Export-Import Bank was founded by the government in 1934 as a very limited substitute. As the Bank's role expanded through the years, the type of loans made by the Bank has changed according to the dictates of American foreign economic policy. But the Bank's primary goal has always been the financing of United States foreign trade.

Because of its infinitesimal loss record, the Bank's major lending criteria should perhaps have considerable practical and theoretical significance as guides to long-term foreign lending. A study of the Bank's published reports and internal memoranda reveals four such criteria.

First, no loan shall be made except for the dollar costs of the loan project. Second, each loan must be capable of being repaid in dollars. Third, loans shall be made for specific purposes only; this is interpreted to mean that the Bank's staff will investigate each loan application to discover whether the project is within the technical abilities of the borrower, and whether the project is domestically solvent; it is also interpreted to mean that each loan project will generate sufficient dollar exchange to amortize the loan. Fourth, all loans must be in harmony with the general economic and political goals of the United States. Examination of the first three criteria reveals that they are inconsistent with widely accepted economic principles. But such divergences must occur if the Bank is to conform to the more important "public policy" criterion.

Tied loans -- the Bank's first criterion -- are shown to be less strict in application than is generally believed. Study of the internal memoranda shows that the Bank has made several exceptions to this rule when there are strong enough policy reasons for doing so. While tied loans tend to misallocate world resources, the strongest argument against the dollar-cost-only rule is political. As long as the United States is a strong supporter of unfettered free trade, the bilateral effect of many Eximbank loans is in opposition to stated government policy.

Various devices used to make loans supposedly more credit worthy have been found to be wanting. Official government guaranties have been rejected by the Bank because they lead to political intervention. Rapid amortization, a technique used by the Bank, probably has forced the Bank to renegotiate some loans in order to forestall default. The almost default-free record has been maintained by flexibly working out new loan arrangements when borrowers begin to face difficulties.

Despite some exceptions, specific-purpose lending has been the mainstay of Bank policy. This technique has enabled the Bank to provide valuable managerial services to borrowers, thus helping to overcome the problems of an unsuitable investment environment. The dollar gaining or saving aspects of basic social capital loans have been ignored when other policy factors have been determining.

Coordination of Eximbank loan policy with over-all governmental policy has been consistently difficult. Though the Bank likes to act as if it were an independent institution, it has been forced to conform to a higher level of government policy; yet it has refused to make certain submarginal loans simply to advance American political aims.

Shifting government policy has made the Eximbank a somewhat fickle lending institution. Qualified borrowers have not always received loan accommodation; unqualified borrowers have not always been rejected. But the Eximbank clearly has played a useful role; and, considering the change in the international financial position of the United States in 1958-1959, it is likely that it will provide an even larger proportion of total foreign financial assistance, since Congress considers that its operations increase American exports.

Microfilm \$7.10; Xerox \$25.20. 559 pages.

# AN APPROACH TO THE ANALYSIS OF COMMON SHARE PRICES

(L. C. Card No. Mic 60-5837)

Robert C. Ortner, Ph.D.  
Columbia University, 1960

The present value of an asset is the sum of the present values of all future returns attributable to the asset. In the case of a share of common stock, the returns are derived from two sources, dividends and future sale. Thus, if  $D$  equals each future dividend,  $M$  equals market value at some future point in time,  $n$  the number of years from the present (or the time horizon), and  $i$  the expected yield, the present value,  $V$ , is given by

$$(1) \quad V = \frac{1 - (1 + i)^{-n}}{i} D + (1 + i)^{-n} M,$$

if  $D$  is constant, and by

$$(2) \quad V = \frac{1 - \left(\frac{1 + r_d}{1 + i}\right)^n}{i - r_d} D + (1 + i)^{-n} M$$

if the dividend stream beginning with  $D$  is expected to grow at the rate  $r_d$  per period. In accord with suggestions of other writers (e.g. Hart, Musgrave, Modigliani) the expected rates of growth  $r_d$  and  $r_p$  - are assumed to be held with uncertainty.

For empirical purposes (2) is not satisfactory. An algebraic equivalent must be derived in which all the variables are observable and provide a meaningful relationship. One possible statistical function is

$$(3) \quad P_0 = a_0 + b_0 D_0 + c_0 P_{-1} + \mu_0.$$

Comparing (3) with (2), we have

$$(4) \quad b_0 = \frac{1 - \left(\frac{1 + r_d}{1 + i}\right)^n}{i - r_d} \quad \text{and}$$

$$(5) \quad c_0 = (1 + r_{p0}) \left(\frac{1 + r_p}{1 + i}\right)^n$$

where  $1 + r_{p0} = \frac{P_0}{P_{-1}}$ , and  $M = P_0 (1 + r_p)^n$ .

The coefficients  $b_0$  and  $c_0$  may be found by regression analysis; and if estimates may be made of  $r_d$  and  $r_p$ , (4) and (5) are two equations in two unknowns,  $n$  and  $i$  - the time horizon implied by market behavior and the expected yield.

In attempting to find  $r_d$  and  $r_p$ , the recent work of Koyck, Cagan, Friedman, and Nerlove is relevant. For the derivation of expectations, Koyck suggested a weighted average of past observations, with the weights in the form of a diminishing geometric progression. Cagan, and later, Friedman, offered the hypothesis that people adjust their expectations from one period to the next in proportion to the error in their previous expectation. It may be shown that Cagan's approach reduces to Koyck's. These ideas, in combination with variations of (3), provide a number of equations to be examined empirically.

The data used for the statistical analysis covered the period 1935-55 and were made available by Professors Cottle and Whitman. They consisted of 128 of the largest industrial companies drawn from a wide list of industries. Typically, the values of the coefficients of determination were of the order of 98 and 99%. The important determinants of present price were previous price, present dividend, and recent rates of change in price. For individual years, however, the Cagan-Friedman approach was not too helpful in isolating the expected rates of change. Nevertheless, for all years together, recent rates of change in price were important independent variables, and their importance diminished as they receded in time from the date of the independent variable. Thus  $r_p$  was estimated by a weighted geometric average of past observed rates with weights diminishing. Recent changes in dividends were, generally statistically non-significant, and so different possibilities were offered for  $r_d$ . It turned out that varying  $r_d$  mattered little to the computed values of the time horizon, which were generally small. Only once in 16 years did  $n$  exceed 10; usually it was less than 5, and twice, less than 1 year. The expected yield varied from a slight negative return to about 20% per annum.

Microfilm \$2.50; Xerox \$6.60. 136 pages.

## ECONOMICS, HISTORY

### POWER ON THE PLAINS, A BUSINESS HISTORY OF THE DEVELOPMENT AND OPERATION OF PUBLIC POWER IN NEBRASKA.

(L. C. Card No. Mic 60-5572)

Robert E. Firth, Ph.D.  
The University of Nebraska, 1960

Adviser: Charles Sidney Miller

Nebraska is the only state in the Union that has no private power utilities operating within its boundaries. The entire state is served by public power districts and a few rural electrical cooperatives.

Interest in public power development was first spawned in Nebraska by a demand for irrigation to relieve drought and depression among the farmers in the late 1800's and early 1900's. Projects promoted during this period usually included plans for hydroelectric dams in order that electric revenues might subsidize irrigation services. These early efforts failed, however, for lack of a feasible plan for financing such projects.

In 1933, money suddenly became available through the "New Deal" program of the Roosevelt Administration. Three projects for the development of power and irrigation facilities received loans and grants from the PWA. One project was in the Sutherland-North Platte area, another in the Hastings, Minden, and Holdrege area, and the third was located in the vicinity of Columbus. Also in 1933, the Nebraska Legislature passed the Enabling Act which made it possible to organize public power and irrigation districts and for such districts to borrow funds from the federal government.



Once the projects had been constructed, new problems arose. Nebraska was already being served by private electric companies. In order to secure a market and make it possible to liquidate their loans, the three districts attempted to purchase the private power companies. These efforts failed, and the Consumers Public Power District was formed to accomplish this task. Within a year and a half, Consumers had purchased all of the private companies in the state except the one serving Omaha. This was later purchased by the Omaha Public Power District.

By 1940, it was necessary for the three hydro projects to refinance their loans with the PWA. In connection with this refinancing plan, the three districts formed a joint operating organization, the Nebraska Public Power System, to coordinate their activities.

This organization carried on its functions through a Board of Managers composed of the general managers of the three districts and the executive director of the new organization. The Board of Managers is responsible for the pooling and dispatching of power loads, the pooling of revenues, making power contracts, setting of rate structures, planning for future expansion of facilities, and coordinating the use of water resources. It was originally the purpose of NPPS to be the power supplier for the state while Consumers and the rural districts would be the distributors of electricity to the ultimate customers.

Every public power district in Nebraska is controlled by a board of directors elected by the voters within its boundaries. These boards set policies and choose the operating managers of their districts. The management of these districts is not subject to the control of any state regulating commission or statewide coordinating body.

Nebraska's public power organizations faced their most serious problems after World War II. Power demand quadrupled in a ten year period forcing new construction, new financing, and reorganization of relationships between the power districts. It became a period of conflict and disagreement between them. Several important court battles were fought over issues which arose, some of which have not yet been settled.

Nebraska's public power program faces several possible developments in the future. The Enabling Act needs revision to meet new relationships which have arisen. Control by a public commission is contemplated by some. There is also a possibility of merger among the power agencies to prevent the reoccurrence of some of the problems of the past.

Microfilm \$7.95; Xerox \$28.15. 625 pages.

## ECONOMICS, THEORY

### A STUDY IN THE CONCEPT OF BALANCED DEVELOPMENT WITH PARTICULAR REFERENCE TO THE NURKSIAN DOCTRINE OF BALANCED GROWTH

(L. C. Card No. Mic 60-5128)

Yoon-Bock Awh, Ph.D.  
The University of Florida, 1960

This study is a critique of the doctrine known as "balanced growth" proposed by the late Professor Ragnar Nurkse in his 1953 volume, Problems of Capital Formation in Underdeveloped Countries. It tries (1) to identify the Nurksian doctrine of balanced growth as to its content as well as to its origins, (2) to evaluate the doctrine within Nurkse's own set of presuppositions and his own framework of analysis, and (3) to re-evaluate the doctrine in terms of the larger framework of capital formation and economic development of underdeveloped countries so as to see the full potentialities and limitations of a theory of balanced development or growth.

The writer found the Nurksian analysis a significant contribution towards the understanding of the problems of capital formation. The Nurksian thesis, however, falls far short of a satisfactory theory of balanced growth. Its assumption regarding the demand condition is unnecessarily strict, and the assumption of the private enterprise economy rather unrealistic. Nurkse's solution of horizontal balance -- by the very logic of its own argument -- must be extended to include not only the consumer-goods industries but also various other branches of the economy producing final goods.

Though Nurkse abstracted from the supply analysis, the proposal of horizontal balance cannot legitimately abstract from supply considerations. As soon as the supply side is introduced into the picture, it becomes clear that not only demand deficiency but also the lack of social overhead facilities and of related industries which supply external economies is deterring capital formation in underdeveloped countries. Extending the Nurksian logic to the supply side, a solution of vertical balanced development -- a more or less simultaneous development of various stages of industries -- is proposed to overcome the difficulties caused by the lack of external economies. As the demand and supply sides of capital formation are closely related, a solution to overcome the difficulties both on the demand and supply sides is then horizontal and vertical balanced development -- i.e., a more or less simultaneous development of various branches of an economy at various stages of production. In view of the differences in resource endowments and capital supply among different countries, it is clear that the scale and content of balanced development programs of different countries should be different. Thus, the study emphasizes the relativity of the concept of balanced development. Whether a development program is balanced or not must be determined with specific reference to the domestic and international market conditions as well as the supply conditions including capital supply and resource endowment.

The study recognizes the difficulty involved in the development of a complete theory of balanced development and recommends the use of the concept of balanced development as a macro-investment criterion only. As a macro-criterion, it can help guide development policy

makers by emphasizing the need of large-scale effort, of balance among sectors, of industrial development, and of dynamic considerations.

The study presents the case for the preservation of the concept of balanced development as the macro-criterion, but it also shows the complementarity of the two seemingly opposing concepts, viz., balance and priority.

Microfilm \$2.50; Xerox \$8.40. 183 pages.

# CONSUMPTION, INVESTMENT AND THE LOWER TURNING POINT OF SEVERE DEPRESSIONS.

(L. C. Card No. Mic 60-5839)

Alan Spiro, Ph.D.

Columbia University, 1960

The purpose of this paper is to introduce an alternative statement of the consumption function that will both explain the consumption data and, when introduced into a business cycle model, will produce a more satisfactory lower turning point than have other consumption functions.

It is assumed that:

$$C_t = r_t + BW_t + A \sum_{i=0}^{i=n} a_i \cdot y_{t-i}$$

Where: C = deflated consumption

W = cumulated deflated savings

y = deflated measured income

r = an error term which measures the effect of all other forces (including capital gains and losses)

A, B and the set of a's are fixed coefficients

However, this equation necessarily implies that W is measured by an arithmetic average, with fixed weights, of past and present levels of y and r. Therefore, the consumption function can, without loss of generality, be reduced to:

$$C_t = R_t + \sum_{i=0}^{i=\infty} b_i \cdot y_{t-i}$$

In this equation, the set of b's are fixed coefficients which measure both the influence of past levels of income and of past levels of saving (i.e. measure both the influence of permanent income and of wealth). R is an error term which measures the effect upon consumption of all other forces (including capital gains and losses). The central point of the paper is that:

$$\sum_{i=0}^{i=\infty} b_i = 1$$

As a result, over sufficiently long periods of time, the multiplier is infinite. It is demonstrated that this consumption function is consistent with (indeed can be regarded as one version of) Professor Friedman's theory of consumer behavior.

This consumption function (with R = 0) explains the available consumption data a trifle better than do alternative statements of the consumption function. Further, when incorporated into a business cycle model, a more satisfactory lower turning point is produced than is obtained by models that use alternative consumption functions. Microfilm \$2.50; Xerox \$5.40. 108 pages.

## EDUCATION

### EDUCATION, GENERAL

#### CURRICULUM AND OTHER IMPLICATIONS RESULTING FROM A STUDY OF THE GRADUATES AND DROP-OUTS OF THE TERMINAL VOCATIONAL INDUSTRIAL EDUCATION PROGRAM AT THE NORFOLK DIVISION OF VIRGINIA STATE COLLEGE, 1950-1954.

(L. C. Card No. Mic 60-5415)

James Albert Bowser, Ed.D.

The Pennsylvania State University, 1960

#### Procedure

The sources of data were questionnaires, school records, interviews, and review of literature in the field. The study was based on a follow-up of the drop-outs and graduates of the terminal vocational trades program at

the Norfolk Division during the period 1950 through 1954. Data were secured from drop-outs by means of a questionnaire designed to determine reasons for drop-outs. Relevant data concerning graduates' background, employment, occupational adjustment, and their opinions of the program were secured by means of personal interviews. Additional data were secured from Negro Land Grant Colleges, pertinent literature and school records. In the analysis of data, comparisons were made between graduates employed in the trade fields for which they trained and graduates not employed in fields for which they trained. Interviews were held with 107 of the 144 graduates and usable returns were received from 124 of the 292 drop-outs.

#### Findings and Conclusions

Fifty-six per cent of 107 graduates contacted were employed in the trades or trade fields for which they trained. Nine per cent were employed in trade or occupations related to trades other than the ones studied.



Thirty-one per cent were engaged in occupations not related to trades and 3.7 per cent were unemployed. Background factors including age, marital status, level of schooling, veteran's status, additional education and different influences on vocational choices were not of any major consequences in determining successful placement. The two major factors which contributed to success in finding employment in the trade fields for which graduates trained were luck and the kind of help received from job-referral sources. Of the graduates who found employment in their trade fields, 73 per cent were employed two months after graduation and 94 per cent were employed six months after graduation. Early first job placement in their trade fields seemed to be an important factor for holding graduates in the trade fields of their training. Most graduates working in their trade fields found employment with the help of friends while graduates not employed in their trade fields sought jobs on their own. Principle job-referral sources used by graduates were friends, relatives, civil service, and own efforts. Neither the state employment service nor the school was very effective as a job-referral source. The Negro Land Grant Colleges utilized the services of the dean, the registrar, the public relations officer, the director and trade coordinator to place vocational trade graduates. Procedures found to be most helpful by Negro Land Grant Colleges in placing their graduates were: (1) contact with employers by school officials, (2) internship programs, (3) assistance from alumni, and (4) the use of advisory committees. Limited practical experience was the greatest single obstacle to placement of graduates in fields of their training. Other obstacles were racial employment policies of employers, lack of jobs, and development of new interests by graduates. Voluntary job changes of graduates tended to show a desire to improve economic status. "Job ending" was the reason for most involuntary job changes. This was the result of conditions inherent in certain trades and was almost totally confined to the building trades. Graduates working in their trade fields received higher average weekly salaries than other graduates not working in their trade fields although there was no significant statistical difference in their job entrance salaries. Graduates were generally pleased with the trade program but there was little agreement among them as to what should be emphasized in the various trade courses. Limited program offering and low economic status of enrollees in the vocational trade program were the underlying causes of most drop-outs. Vocational trade programs in the local area, including apprenticeship, were inadequate to meet present and anticipated future needs of the community.

Microfilm \$2.80; Xerox \$9.70. 213 pages.

# INSTRUCTIONAL MATERIALS IN SOCIAL STUDIES FOR SUPERIOR PUPILS IN THE INTERMEDIATE GRADES

(L. C. Card No. Mic 60-5648)

Harriet Marie Ebeling, Ph.D.  
State University of Iowa, 1960

Chairman: Professor Herbert F. Spitzer

The purpose of the present study was to prepare instructional materials in social studies which would challenge superior pupils in regular fifth-grade classrooms. To accomplish this purpose the following three units were prepared, each related to the regular fifth-grade social studies curriculum, which is essentially the geography and history of the United States:

- 1) Problems of Map Making
- 2) Explorations in America before Columbus
- 3) Little-Known Heroes of the American West.

Most of the materials used in connection with the units were at a level of difficulty higher than that generally designated as fifth-grade. The plan was to have the materials interesting enough to attract the typical fifth-grade pupils and yet of such difficulty that only the superior would be challenged by them; the superior pupils themselves would elect to work on the special units, while the remainder of the class would continue to do the regular social studies work. The proposed plan was as follows:

- 1) Approach is used with entire class to arouse interest.
- 2) Entire class has opportunity to look over the materials, and each member decides whether or not to volunteer to take part.
- 3) Teacher emphasizes the difficulty of the materials.
- 4) From list of volunteers the teacher makes final decision of who may work with the materials.
- 5) These pupils work either individually or in groups, as they and the teacher decide. They are excused from the regular social studies work.
- 6) The remainder of the class continues with the regular work.
- 7) The special group reports to the rest of the class, in whichever way they and the teacher decide.
- 8) Evaluation is done informally (no formal testing or "culminating activity.")

To see if this process of self-selection would function as planned, the three units were tried out in public school classrooms. Although suggestions of how to proceed were given to the teachers, the actual use of the materials was left to each teacher's judgment. Four classrooms were used. These were chosen because of convenient location and after personal conferences with local school officials. Evaluation was entirely subjective, based on the following criteria:

- 1) Pupil questionnaires
- 2) Teacher questionnaires
- 3) Reports of teacher interviews.

The writer feels that in this kind of study a subjective observation is the best evaluation.

### Conclusions:

From the results of this study the following conclusions were drawn:

- 1) Pupils' reactions to the materials were decidedly favorable. It was found that with few exceptions those pupils judged superior by the teachers were challenged by the special units constructed for this study.
- 2) Teachers' reactions were favorable to the materials. In general they followed the methods suggested, with modifications to suit their particular situation and class.
- 3) The proposed plan did function as a method of "self-selection" of the superior. With few exceptions the pupils considered by the teachers as superior were the ones who volunteered to take part in the work with the special units.
- 4) It is possible to select from the available information relating to the areas studied in social studies by fifth-grade pupils material that will challenge the good reader, and it is possible to construct worksheets or study guides which give adequate general directions but yet allow for specific individual interests.

Microfilm \$2.60; Xerox \$9.00. 198 pages.

### AN APPRAISAL OF TEACHER KNOWLEDGE OF PHONETIC ANALYSIS AND STRUCTURAL ANALYSIS

(L. C. Card No. Mic 60-5226)

John Thomas Farinella, Ph.D.  
The University of Connecticut, 1960

#### Statement of the Problem

The purpose of this study was to attempt to secure an appraisal of teacher knowledge of those word-attack skills authorities claim should be taught.

To accomplish this general purpose, an effort was made to achieve the following objectives: 1. To determine the extent to which certain authorities in the field of reading instruction agree or disagree on the word-attack skills that should be taught. 2. To determine the extent to which teachers have a knowledge of the skills on which the authorities agree.

#### Procedure

The solution of these problems involved the following steps:

1. An analysis of the teachers' manuals of four widely-used elementary basal reading series was made.
2. From the analysis of teachers' manuals was determined:
  - a. Principles and skills of phonetic and structural analysis recommended.
  - b. Principles and skills of phonetic and structural analysis common to all four basal reader series examined.

3. A test was constructed to appraise teacher knowledge of those skills.

4. The test was administered to a special group known to have knowledge of those skills.

5. A sample group of 394 teachers in grades one through six was tested.

6. Test data were treated as follows:

a. The performance of the special group was compared with that of the sample group

b. Data from the sample group led to the following comparisons:

(1) Comparison of performance of teachers in grades one to three with that of teachers in grades four to six

(2) Comparison of teacher college graduates with liberal arts college graduates

(3) Comparison of non-degree teachers, bachelor's degree teachers and master's degree teachers

(4) Comparison of teachers with no graduate credits, one to five graduate credits, and six or more graduate credits in reading.

#### Results

An analysis of the data yielded the following results:

1. All four basal reader series surveyed contained comprehensive programs for the teaching of phonetic and structural analysis.

2. Considerable agreement was found as to what principles and skills of phonetic and structural analysis should be taught.

3. The special group achieved a mean score of 76.91 out of a possible eighty-four. In contrast, the sample group achieved a mean score of 43.97.

4. No significant difference was found between primary grade and intermediate grade teachers in their knowledge of phonetic analysis.

5. The intermediate grade teachers did significantly better than primary grade teachers on structural analysis.

6. No significant difference was found in the performance of teacher college graduates and liberal arts college graduates.

7. No significant difference was found in the knowledge of phonetic and structural analysis as demonstrated by teachers with no graduate credit, those with one to five and those with six or more graduate credits in reading.

8. No significant difference was found in the knowledge of phonetic and structural analysis as demonstrated by teachers with no degree, teachers with a bachelor's degree and teachers with a master's degree.

#### Conclusions

Study of the data led to the following conclusions:

1. The teaching of phonetic and structural analysis is advocated by the authors of the leading basal reader series.

2. There is a body of skills and principles of phonetic and structural analysis upon which authors of basal readers agree.

3. An alarmingly large number of teachers showed a marked deficiency in their knowledge of the phonetic and structural analysis skills the authorities claim should be taught.

4. The type of college attended made no significant difference in teacher performance on the Phonetic and Structural Analysis Test.



5. Courses in the teaching of reading have dealt ineffectively with phonetic and structural analysis.

6. An advanced degree could not be taken as an indication of better knowledge of phonetic and structural analysis than before having earned that degree.

Microfilm \$2.65; Xerox \$9.25. 204 pages.

#### THE INFLUENCE OF COLLEGE READING INSTRUCTION UPON ACADEMIC ACHIEVEMENT

(L. C. Card No. Mic 60-5619)

Doris Virginia Gunderson, Ph.D.  
University of Minnesota, 1960

The investigation was designed to ascertain the influence of reading instruction upon the academic achievement of college freshmen in specific content areas and to assess the influence of scholastic aptitude, reading ability, and sex as contributors to academic success in these areas. Interaction of instruction, scholastic aptitude, reading ability, and sex upon academic success was studied. The population consisted of 482 college freshmen enrolled at Concordia College, Moorhead, Minnesota, in 1957-58 and 1958-59. As it was impossible to assign students randomly into the reading classes, the study is an appraisal of the success in college of students who volunteer for and receive reading instruction compared with students who do not volunteer and do not receive reading instruction.

Tests used were the American Council on Education Psychological Examination and the Reading Section of the English Cooperative Test. The population was divided into halves in both intelligence and reading levels as determined by the tests.

The statistical technique employed was the analysis of variance which was used to test the significance of the difference of the mean scores of the four main effects and the interaction among them. Variables in the four-way analysis were enrollment or non-enrollment in reading class, reading level, ACE level, and sex.

The null hypotheses stated that there was no significant difference in academic achievement in each of the college courses considered in the study between enrollment or non-enrollment, the two reading levels, the two ACE levels, and the sexes, or between the first order interactions among these four variables. The hypotheses were tested in each of the following courses: English, sociology, religion, history, biology, mathematics, and chemistry.

Among the conclusions drawn from the findings was a significant difference in mean grade point average between students enrolled and students not enrolled in reading classes in English and religion at the .01 level and in chemistry at the .05 level. Such findings suggest that gains in reading are reflected more quickly in academic success in English and religion than in other courses. There was a significant difference in mean grade point average between students in the upper and lower reading levels in English, sociology, history, and religion at the .01 level, and in chemistry at the .05 level. In courses which require extensive reading of materials similar to that included in the reading test, reading level appears to be important to academic success. There was a significant

difference in mean grade point average between the two sexes in English, religion, and mathematics.

There was a significant ACE level by reading level interaction in English. It indicates that students who have either high ACE or high reading levels or both make high English grades, but that students low in both ACE and reading levels have little chance for success in English courses.

There was a significant sex by enrollment or non-enrollment interaction in religion and history; interpretation indicates that enrollment influenced the grades of men more than it did those of women in the two courses. There was a significant reading level by enrollment or non-enrollment interaction in biology; enrollment appeared to be more beneficial for poor than for good readers.

It was shown in the study that college students who benefit most from reading instruction are those with initially high ACE and low reading levels. Reading ability was highly related to success in all the subject matter areas considered. An examination of the interactions among the various college courses revealed that reading classes appear to be more beneficial for men than for women, for poor readers than for good readers, and that they are particularly of benefit for students with high intellectual capability and low reading ability.

Microfilm \$2.50; Xerox \$6.80 142 pages.

#### A COMPARATIVE STUDY OF ESTIMATED ACHIEVEMENT BY INDUSTRIAL ARTS STUDENTS AND STUDENTS OF COOPERATIVE WORK EXPERIENCE SELECTED FROM THE PUBLIC SECONDARY SCHOOLS OF PENNSYLVANIA, OHIO, AND MICHIGAN.

(L. C. Card No. Mic 60-5437)

Robert Henry Hawlk, Ed.D.  
The Pennsylvania State University, 1960

#### THE PROBLEM

This study was designed to compare the estimated achievement of validated industrial arts objectives by selected industrial arts students and cooperative education students in public schools of Ohio, Michigan, and Pennsylvania.

#### THE PROCEDURE

The plan for accomplishing the objectives of this study was based upon a null hypothesis which was postulated as follows:

Cooperative work experience students will show the same estimated degree of attainment of validated industrial arts objectives as do industrial arts students who study in regularly scheduled course work within the environment of the industrial arts facilities of the public secondary school.

The procedure involved several related steps. A list of validated industrial arts objectives was secured. These industrial arts objectives were accompanied by lists of student behavior which characterized each respective

objective. From these lists of student behavior four similar questionnaire forms were developed and validated. Reliability for the questionnaire forms was established. The questionnaire forms were designed for response by industrial arts instructors, coordinators of cooperative work experience, industrial arts students, and students of cooperative work experience.

A total of 585 questionnaires was used in the compilation of the data. This constituted seventy-four per cent of the questionnaires mailed to selected respondents.

Data secured were compared by using averages, high estimates of achievement, and significant differences of means.

#### MAIN CONCLUSIONS

1. Students of cooperative work experience achieve at a higher estimated level than industrial arts students in regard to six of the nine validated industrial arts objectives. These six objectives are: Interest in Industry, Cooperative Attitudes, Health and Safety, Interest in Achievement, Orderly Performance, and Shop Skills and Knowledge.

2. Industrial arts students achieve at a higher estimated level than students of cooperative work experience regarding the industrial arts objectives Appreciation and Use, and Drawing and Design.

3. One industrial arts objective, Self-realization and Initiative, was achieved at approximately the same estimated level.

4. Environmental factors appear to effect the estimated level of achievement, when industrial arts students are compared with students of cooperative work experience.

5. According to available evidence, the adaptation of the techniques of cooperative work experience may provide a means for implementing the philosophy of progressive intensity as it relates to industrial arts education.

Microfilm \$2.75; Xerox \$9.70. 211 pages.

#### ISSUES IN THE EDUCATION AND GUIDANCE OF SUPERIOR HIGH SCHOOL STUDENTS

(L. C. Card No. Mic 60-3213)

Kenneth Charles Hoedt, Ph.D.  
The University of Wisconsin, 1960

Supervisor: John W. M. Rothney

Two hour structured interviews were held with the principals of 46 schools cooperating with the Research and Guidance Laboratory for Superior Secondary School Students at the University of Wisconsin. The purpose of the interviews was to determine: (1) the administrative problems that they associated with the implementation of twenty procedures recommended for superior students by counselors at the Laboratory, (2) the extent to which they would support them, and (3) their estimates of the value of the procedures for superior youth. Five of the procedures dealt with students' programs. They required the schools to: permit registration in advanced courses, concurrent enrollment in algebra and geometry, class

attendance on alternate days, correspondence study, and early graduation. The counselors had also advocated provision of information about the pros and cons of attending various colleges, individual guided reading programs, opportunities for individual projects, scholarship and vocational information, individual counseling, and tutorial assistance for academic problems. In addition, the counselors at the Laboratory had recommended the planning of programs individually, more stringent correction of spelling and English errors, the substitution of creative writing for grammar, the holding of conferences with parents, placing greater emphasis on written assignments, and the encouragement of superior students to elect a foreign language, participate in extra-curricular activities, and elect five academic subjects.

The population of the study included 23 principals of schools of less than 450 students and 23 from larger schools. In answering questions about the procedures, they were asked to consider the reaction of parents of superior students, parents of other students, citizens of the community, and members of boards of education. The adequacy of space, staff, and equipment were considered along with possible effects of the procedures on school scheduling and upon the superior students themselves. Items of cost, teacher training, the extent to which the procedures were currently used, and their potential value was examined.

The principals indicated the degree to which they would support utilization of the procedures by rating them on a five point scale that ranged from vigorous support to strong opposition.

Analysis of the data revealed that: (1) large schools used significantly more of the twenty procedures than small schools, (2) there was little difference in the problems related to implementation of procedures and the amount of administrative support they would receive in large and small schools, (3) the most frequently reported problems in implementing the procedures were staff opposition, undesirable effects on superior students, inadequately prepared teachers and lack of strong support by principals, (4) principals reported that their teachers were not all prepared to provide guidance services but many were assigned such duties in two-thirds of the schools, (5) the principals' responses indicated that cost, space, equipment, scheduling the procedures into the regular school program, and reaction from the community were least likely to prevent their use, (6) a majority of principals of both large and small schools vigorously supported and attempted to provide for the use of 16 of the 20 procedures. None of the procedures, however, was strongly supported by more than 89 percent of the heads of schools.

Although most principals do have a positive attitude toward the procedures all of them are not likely to support any particular one. Generally the findings of the study imply that it is necessary that counselors study the characteristics and needs of individual schools before recommending procedures designed to enhance the education of superior students.

Microfilm \$2.50; Xerox \$8.20. 176 pages.



**CERTAIN PARENTAL FEELINGS  
TOWARD SELECTED ASPECTS OF A  
UNIVERSITY LABORATORY SCHOOL**

(L. C. Card No. Mic 60-5138)

Warren Alonzo Land, Ed.D.  
The University of Florida, 1960

The primary purpose of this study was to ascertain parental feelings toward selected aspects of a university laboratory school and to relate these feelings to certain parental classifications. This study was specifically directed toward answering the following questions:

- A. How do parents who have children currently enrolled in the P. K. Yonge Laboratory School of the University of Florida feel toward the following aspects of the school:
  1. Stated purposes of the school?
    - a) Importance of the school goals?
    - b) Effectiveness of the school goals?
  2. Program of the school?
    - a) Elementary school program?
    - b) Secondary school program?
  3. School Staff?
    - a) Elementary school staff?
    - b) Secondary school staff?
  4. Additional functions of the school?
    - a) Acceptance of the additional functions?
    - b) Knowledge of the additional functions?
- B. Is there a positive correlation between:
  1. Length of parental association with the school and favorable feelings toward the school?
  2. Frequency of parental involvement in school activities and favorable feelings toward the school?
  3. Frequency of parental interaction with the school staff and favorable feelings toward the school?
  4. Length of parental residence in the school community and favorable feelings toward the school?
  5. Primacy of the source of parental information concerning the school and favorable feelings toward the school?
  6. Source of parental employment (University of Florida employed or non-University of Florida employed) and favorable feelings toward the school?
  7. Grade level of the child enrolled (elementary only, secondary only, elementary and secondary) and favorable feelings toward the school?

It was decided that the most reliable and most effective method for collecting the necessary information concerning parental feelings toward the school would be through the use of a questionnaire which would assure anonymity of the respondents. Since an adequate instrument to collect these data was not available, a suitable one was developed.

A questionnaire was sent to each of the 581 families who had a child enrolled in the P. K. Yonge Laboratory School in June of 1959. Of the 581 questionnaires distributed, 93 per cent were returned. Of the questionnaires returned, 88 per cent or 514 were considered usable.

Analysis and tabulation of the data indicated that parents rated all aspects of the school as good or very good. The feeling score (5, very good; 4, good; 3, fair; 2, poor; 1, very poor) for all of the 514 families for six aspects of the school are as follows: Goal Importance, 4.73; Goal Effectiveness, 4.00; Elementary School Program, 4.10; Secondary School Program, 4.02; Elementary School Staff, 4.42; Secondary School Staff, 4.20.

Parents indicated their approval of the additional functions of the school. Eighty-five per cent of the families indicated their acceptance of the Additional Functions while sixty-eight per cent of the families indicated knowledge of the Additional Functions.

In the second phase of the study, responses were divided according to seven major parental classifications. Statistical treatment of the data through the use of the "t" test and the "F" test indicated that there was not a significant difference at the 1 per cent level of confidence between the seven major parental classifications and favorable feelings toward the various aspects of the school.

In conclusion, parents of the P. K. Yonge Laboratory School rated the various aspects of the school as good or very good. Further, the seven major parental classifications need not affect favorable parental feelings toward the various aspects of the school.

Microfilm \$2.85; Xerox \$5.80. 218 pages.

**INDUSTRIAL RADIOISOTOPE USAGE AND  
TECHNICIAN DEMAND AND TRAINING**

(L. C. Card No. Mic 60-6012)

Raymond Andrew Prosser, Ed.D.  
Cornell University, 1959

The growth in industrial radioisotope usage "mushroomed" during 1955, the year following the passage of the Atomic Energy Act of 1954. Currently, about 40 per cent of all users are industrial firms, contributing \$400 million annually to our economy. During the next decade this contribution is expected to spiral upward, creating concomitant demands for greater quantities of radioisotopes than now can be made available, and for large numbers of qualified technical personnel.

To meet the increasing demand for radioisotopes, private industry is encouraged to own and operate power reactors designed to produce radioisotopes as well as power. Governmental and engineering educational authorities visualize a gradual reduction in the role played by the national laboratories as responsible agents of radioisotope supply and of atomic energy training. Yearly, an increased amount of the technical training required for peacetime applications will be shared jointly by educational institutions and industry.

The primary concern of this thesis is with adequate safety instruction of technicians using radioisotopes in industry. Regulations of the AEC set the stage by making

radiological qualifications of responsible personnel a determinant in by-product licensing, and by mandating certain fundamental training of radiation workers in exposure hazards and precautions.

Informed authorities are firm in their stand that technical manpower must be found and trained to perform atomic energy activities, particularly below the engineering level, and that the demand for such workers will mount sharply with increasing use of power and non-power applications.

New York State, the geographical area of greatest industrial radioisotope use, was surveyed to determine technician requirements over the period 1957 through 1959. A questionnaire was designed to promote responses of demand and training needs for full-scope radioisotope usage, and was forwarded during January 1957 to all active industrial firms. Eighty-six percent of these firms responded.

The technician demand for the survey period was 831, while the demand at the close of 1956, the statistical reference of the research, was 540. The technician work force in radioisotope usage in New York State, therefore, will total 1371 by the end of 1959.

Demand outcomes were summarized under three groups of application classifications: Gaging and Radiography, Research and Development, and Miscellaneous Usages. The future emphasis in demand for the first group is expected to decrease, while for the second and third groups increases are anticipated. The strongest single demand of the miscellaneous group is identified with Process and Resale in contrast to Tracing which predominated in 1956.

Numbers of technicians required per engineer or scientist were computed as: 2.5, 1.0, and 0.75 for the three groups mentioned, respectively, while 1.22 was found applicable to the average installation.

The data point up industry's reliance on both college and below-college disciplines for preparing new entrants. Over the three years the following percentage increases in technician demand in terms of pre-employment preparation are reported: 20.40 from academic high schools, 314.51 from secondary vocational and technical schools, 164.08 from technical institutes, and 160.92 from college-degree courses. The highest percentage listed was considered indicative of a fresh viewpoint by industry of technician qualifications for the more routine technical jobs.

Supplemental instruction in six subjects was emphasized to meet urgent needs of workers in the "fringe" areas: Electronics, Chemistry, Instrumentation, Physics, Mathematics, and Metallurgy. College instruction was recommended for Chemistry, Physics, and Mathematics, while technical programs at below-college level were indicated for the others.

The sharing of certain phases of safety education and training between educational institutions and industry constituted the most resolute recommendation of the respondents. The slogan "Safety First" for radioisotope technicians appears outmoded, with "Absolute Safety" the new and challenging concern.

Microfilm \$2.55; Xerox \$8.80. 195 pages.

## A COMPARATIVE STUDY OF INITIAL ACHIEVEMENT OF AGRICULTURAL COLLEGE STUDENTS

(L. C. Card No. Mic 60-6136)

James Donald Thomas Jr., Ph.D.  
Purdue University, 1960

Major Professor: Ralph R. Bentley

**Purpose.** The purpose of this study was to determine whether there were significant differences in the initial college achievement of the agricultural college students who had studied high school vocational agriculture and those students who had little or no high school vocational agriculture.

**Method.** Data upon which the study was based were obtained from the Office of the School of Agriculture and the Office of Admissions of Purdue University. The study included 603 freshmen students who entered the School of Agriculture in the fall semesters of 1957, 1958, and 1959. The sample included only male students who were graduates of Indiana high schools, who came directly to college from high school, and for whom complete data were available. For purposes of comparison, these students were divided into three basic groups: (1) students not having studied high school vocational agriculture; (2) students having one or two units in high school vocational agriculture; and (3) students having three or more units in high school vocational agriculture. In addition, the achievement of the students was compared when they were grouped according to farm or non-farm background and when they were grouped with respect to subject matter background in high school language arts, mathematics, science, social studies, and business education.

For the purpose of this study, initial achievement was measured by (1) first semester grade-point index, (2) first year grade-point index, and (3) grade points received in selected first year college courses in agriculture, science, mathematics, English, and speech. The two-way classification of analysis of covariance was used to determine whether there were significant differences in the initial achievement, with high school rank controlled, between the background groups and among the three basic groups.

**Results.** The following results were obtained from the analyses:

1. Significant differences at the .01 level were found among the three basic groups with respect to the first semester grade-point indices. The adjusted criterion means were highest for Group I, next highest for Group II, and lowest for Group III. No significant differences were found between the farm or non-farm and between subject matter background groups.

2. No significant differences at the .05 level were found among the three basic groups with respect to the first year cumulative grade-point indices. This was also true for both the farm and non-farm background groups and all subject-matter background groups except science. The science background group which had more than two units in high school science excelled the science background group which had two units or less in high school science.

3. When the students in the sample were divided into the three basic groups and farm or non-farm background



groups there were significant differences at the .05 level with respect to grades received in only one of the ten first year college courses. In an introductory animal husbandry course the adjusted criterion means were highest for Group III, next highest for Group II, and lowest for Group I. No significant differences were found between the farm or non-farm background groups.

4. Significant differences were found in the average English composition grades by the language arts background groups. The students having more than three units in high school language arts had higher grades than those students who had three units or less in high school language arts.

5. Significant differences were found in the average general chemistry and algebra grades for the mathematics background groups. In both instances, students having more than two units in mathematics excelled those students having two units or less in high school mathematics.

6. Significant differences were also found between the average grades received in the general chemistry, introductory zoology, and farm mechanics courses for the science background groups. In these courses, the students who had more than two units in high school science had higher grades than students who had two units or less in high school science.

Microfilm \$2.50; Xerox \$8.00. 175 pages.

#### SOME ASPECTS OF MODERN MATHEMATICS

(L. C. Card No. Mic 60-4576)

John Wagner, Jr., Ed.D.  
The University of Texas, 1960

Supervisor: J. W. Reynolds

The central problem of this study was an intensive investigation of the changing concepts and new developments in mathematics of the last decade insofar as they possess potential content for the precollege mathematics curriculum. The basic hypothesis was that there have been significant developments in mathematics--both pure and applied--that should constitute some of the "available" subject matter for curriculum construction. The study, therefore, had as its aim the identification and categorization of the underlying patterns and existent trends in the mainstream of contemporary mathematics. No attempt was made as to what should be included in the school curriculum. The object was to delineate a reservoir of mathematical principles, elements, notions, topics, and concepts which are available for curriculum construction.

The literature of the mathematics field was surveyed. Books and periodical literature were examined toward establishing particularly what patterns of mathematical thought and concepts underlie the work of the last five to ten years. A survey was made of each issue of the following journals, January, 1946, to June, 1959: Bulletin of the American Mathematical Society, The American Mathematical Monthly, and The Mathematics Teacher.

The survey of the literature of the journals of the three leading mathematical research and teaching societies was supplemented by an investigation of the existing

reports of the Commission on Mathematics of the College Entrance Examination Board, Committee on the Undergraduate Program of the Mathematical Association of America, and the School Mathematics Study Group.

A complementary source of data was a series of structured interviews with a sample of twenty-seven prominent mathematicians. The sample was selected as a joint result of their availability to the interviewer and eminent records of distinguished contributions to research mathematics.

The survey and interview data were synthesized. These combined data were analyzed so as to locate and determine the dominant concepts of existing, and possibly future, mathematical research. The data were also organized into a comprehensive form with a delineation of mathematical subject matter which is available for the precollege construction as reflected from research activities.

The data revealed the explosive development of modern mathematics. New subject matter is constantly being developed. Examples would include abstract algebras, algebraic topology, lattice theories, theory of linear spaces, mathematical logic, and the general theory of sets. Older content is being constantly reorganized, extended, and transformed. The survey and interview data all indicated that the characteristics of contemporary mathematics activities include a tremendous development quantitatively, the introduction of new content, the reorganization and extension of older content, and increased emphasis upon the view that mathematics is concerned with abstract patterns of thought. Mathematics is being applied to an ever increasing variety of fields which would include population theory, biomathematics, quality control, econometrics, linear programming, and statistical decision theory.

The implications of these developments for the precollege curriculum were delineated on the basis of course titles. Algebra could be concerned with the study of mathematical structure and deductive reasoning. Orientation could be toward the properties of a number field, the language of sets and a stress on generalization and abstractions. Available for the development of algebra are the various number systems, a modernized notion of variable and function, and inequalities. More advanced courses have available the notions of group, ring, and field.

Number theory would seem to hold promise as a source of topics for the curriculum.

Recent developments in research have revealed faults in the logical structure of traditional Euclidean geometry. Revised sets of various postulate systems have been developed. Concepts of algebra are now available for integration with geometry. An approach to one, two, three, or even more dimensions is possible.

Probability and statistical inference offer inviting topics for inclusion into the curriculum on a variety of grade levels.

Modern analysis with the development of set theory and the associated theory of measure has developed a very general definition of function. This modern concept of function could simplify and unify many apparently scattered notions presently in the curriculum such as function in algebra and correspondences in geometry.

Productive future research is indicated on a variety of fronts. Scope and sequences with these notions should be

developed. Experimentation needs to be performed on topics for the academically talented pupil as contrasted or compared with the less talented pupil. Various programs should be tested in the classroom. Basic mathematical notions should be "programmed" for articulated inclusion in a variety of grades. The problem of teacher training in terms of these newer notions and emphases in mathematics demands a great deal of study.

Microfilm \$2.85; Xerox \$9.90. 218 pages.

#### A STUDY OF REASONS FOR SUCCESS OR FAILURE IN COLLEGE MATHEMATICS COURSES

(L. C. Card No. Mic 60-5262)

Cecilia Theresa Welna, Ph.D.  
The University of Connecticut, 1960

It is the purpose of this study to investigate the reasons why some college students are successful while other college students are unsuccessful in college mathematics courses. It is a purpose of this study to investigate differences between successful and unsuccessful college mathematics students in: vocational interests, personality adjustment, success in high school mathematics and various mathematical and non-mathematical college courses, and certain mental factors.

Three separate questionnaires were constructed, and results from their use were analyzed. One was administered in October of 1959 to mathematics students of Hillyer College of the University of Hartford. A second and third were sent in October 1959 to secondary-school mathematics and college mathematics teachers, respectively, whose names made up the total membership list of the Connecticut Valley Section of the Association of Teachers of Mathematics in New England.

Pearson product-moment correlations were obtained for the group of responding students between average course marks in college mathematics and: (1) Percentile ranks of scores on the Kuder Preference Record; (2) Percentile ranks of scores on the Heston Personal Adjustment Inventory; (3) Average marks in secondary-school mathematics courses; (4) Average marks in college chemistry courses; (5) Average marks in college physics courses; (6) Average course marks in college English; (7) Average marks in college social studies courses; (8) Average marks in modern language courses; (9) Percentile ranks of scores on the California Mental Maturity Test; and (10) Percentile ranks of scores on the American Council on Education Psychological Examination.

Significant Pearson product-moment coefficients of correlation were obtained between Kuder Outdoor, Literary, and Persuasive scales, the ACE Quantitative score, average college physics and English course marks, and average college mathematics course marks for the students defined as successful in mathematics courses. Significant correlations were obtained between Kuder Scientific, Mechanical, and Social Service scales, the Heston Analytical Thinking, Confidence, Emotional Stability, and Home Satisfaction scales, average secondary-school mathematics course marks, and average college mathematics course marks for unsuccessful students of mathematics.

For students required to study mathematics courses but who would not have elected them significant correlations were obtained between average college mathematics course marks and average English and social studies course marks. For students required to study mathematics courses but who would have elected them, significant correlations were found between average college mathematics course marks and average college chemistry, physics, and English course marks, while for the students who elected mathematics courses significant correlations were found between average college mathematics course marks and average secondary-school mathematics course marks and average marks in college chemistry, English, and social studies.

For the Arts and Science students significant correlations were obtained between average secondary-school mathematics course marks, average college chemistry, English and social studies course marks and average college mathematics course marks. Significant correlations were obtained when average college chemistry and average college physics course marks were correlated with average college mathematics course marks for Engineering students.

The contribution of this study may be judged in terms of the possible use that can be made of the suggestions made by the college mathematics students, secondary-school teachers, and college mathematics teachers in the improvement of the future teaching of mathematics and in the revisions of mathematics curricula which are currently being carried on. Marks in various college courses and scores on scales of certain interest, personality and achievement tests may be used to some degree in predicting success in college mathematics courses.

Microfilm \$2.50; Xerox \$8.00. 173 pages.

#### STUDENT SELECTION PROCEDURES FOR THE ACCELERATED COURSE AT THE BALTIMORE POLYTECHNIC INSTITUTE

(L. C. Card No. Mic 60-4935)

Leonard Woolf, Ed.D.  
University of Maryland, 1959

Supervisor: Kenneth O. Hovet

The objectives of this study concerned (1) the processes of student selection to the Accelerated Course at the Baltimore Polytechnic Institute, (2) the effectiveness of these processes of selection, and (3) the identification of available objective factors that might be utilized to improve the method of selection of students to the "A" Course.

To further these objectives 880 students who entered the Course during the September 1948-1952 terms were selected for study. These students were identified as successful and non-successful students and were identified further according to the method that was used to select them for the program. Comparisons and correlations were made between the successful and non-successful groups by utilizing information and test scores that were available in the school records. On the basis of the



comparisons, determination was made as to whether a particular combination of objective test scores might be successfully used as a criterion of selection of students for the Course.

There were two procedures used to select students for the Course. One procedure was used for students entering the program from the public schools of Baltimore City; the other was used for students entering the program from other sources, including the city-private schools and schools outside the city. Both selective procedures required an entering pupil (1) to have a high scholastic average in his junior high work and (2) to be recommended by his principal. Those pupils who came from the Baltimore City public schools were also required to have a minimum I.Q. score of 110 and a reading score of at grade or above. As measured by the success of 880 students in the Course, the procedure followed in the case of the city-public school students was significantly more successful.

On the basis of evidence pertaining to the students examined the following were some of the conclusions reached:

- 1) Scores in I.Q., M.A., arithmetic, and reading represented significant factors in evaluating a student's ability to succeed in the accelerated program at the Baltimore Polytechnic Institute.
- 2) The use of available seventh grade and ninth grade I.Q., M.A., arithmetic, and reading scores as cut-off points in the process of student selection would have improved the effectiveness of the process in the case of the students studied.
- 3) The occupation of a student's parent proved a significant factor in evaluating a student's ability to succeed in the accelerated program.

This study showed that although existing standardized test scores would have proved useful in helping select students to Polytechnic's "A" Course, these scores definitely would be limited as predictors of success in the program. The general statistical nature of the investigation was inconclusive in regard to the discrepancy between existing evidence and accelerated achievement. The investigation, therefore, needs to be extended in an effort (1) to eliminate more of the uncertainty from the student selective process and (2) to find some means to stimulate potential achievers to a higher level of success in the program.

Microfilm \$2.75; Xerox \$9.70. 211 pages.

## EDUCATION, ADMINISTRATION

### AN INVESTIGATION OF CERTAIN FACTORS INFLUENCING THE OPTIMUM SIZE FOR ELEMENTARY SCHOOL ATTENDANCE UNITS

(L. C. Card No. Mic 60-5639)

David Daryl Basler, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor Jerry N. Kuhn

The purpose of this study was to investigate some of the factors that are involved in the determination of the optimum size for elementary attendance units. It attempted to discover answers to the following questions:

- (1) What are the factors that are operative in the determination of the optimum size for elementary attendance units?
- (2) What are the opinions of elementary school principals concerning the importance of these factors?
- (3) What are the opinions of elementary principals concerning the optimum size for elementary attendance units?
- (4) What differences exist in regard to the achievement of elementary units of different size?

An examination of the literature revealed some thirty-eight factors which were believed to be vital to the determination of the optimum size for elementary attendance units. To check the validity of these factors, twenty-three sets of schools (a set consisting of a single-section, double-section and triple-section school matched as closely as possible according to the socio-economic level of the neighborhoods being served by the schools) were selected and the principals of these schools were interviewed. These same sixty-nine principals were asked their opinions concerning the optimum size for elementary attendance units.

An achievement comparison, based upon the Iowa Tests of Basic Skills, was made involving the sixth grades of twenty-nine triple-section schools, fifty-three double-section schools and seventy-one single-section schools located in urban centers of Iowa with populations greater than 7,000. The size of the sample was determined by utilizing all of the schools of specified size that had been that same size for the previous six years and had participated in the Iowa Basic Skills Testing Program during the 1959-60 school year.

The conclusions of the study were as follows:

1. Of the factors identified in the literature as being important to the determination of the optimum size for elementary attendance units, the following, in the opinion of elementary principals, appear to be independent of school size and therefore are of little value in reaching a decision on this issue: recruiting and holding qualified teachers; leadership duties; faculty morale; provision for special services; planning and conference periods; principal's knowledge of pupils' names and parents' occupations; parents' participation in school planning; handling of pupil personnel problems; library facilities;

number of excursions; regimentation and impersonal operation; adequacy of facilities; and variety of courses offered.

2. The following factors appear dependent on size and should be considered carefully when a decision concerning size must be made: amount of principal's time allocated to a school; amount of secretarial help; organization for administration, supervision and instruction; principal's being busy with office routine; staff working as a unit; personal acquaintance of principal with staff; unified staff planning; rigidity of scheduling; playground behavior problems; teachers' knowledge of total pupil enrollment and total parent group; pupils' knowledge of total pupil enrollment; school spirit and pride; closer school-community relations; pupil tension and apprehension; individual pupil problems; extra-curricular activities; ability grouping; standing in line; and rules, regulations and need for passes.
3. Of the six different sizes of schools that were mentioned by the principals, the double-section school (basically a school with thirteen or fourteen teachers or classes of children) was chosen most often as the optimum size.
4. There does not seem to be any difference, statistical or practical, in the achievement of single-section, double-section and triple-section schools when size of community is kept fairly constant.

In the opinion of the writer, the weight of the evidence in this study appears to favor the double-section school as the optimum size.

Microfilm \$3.30; Xerox \$11.50. 254 pages.

**A STUDY OF THE RELATIONSHIPS IN THE  
PLANNING FOR SCHOOL BUILDINGS BETWEEN  
THE CITY PLANNING AGENCIES AND  
SCHOOL AUTHORITIES IN AMERICAN  
CITIES OVER 100,000 POPULATION**

(L. C. Card No. Mic 60-5593)

Frank Raymond Braun, Ph.D.  
University of Minnesota, 1960

Adviser: Dr. O. E. Domian

The purpose of this study was to describe the participation by city planning agencies and school districts in the planning for school facilities and to suggest means by which close cooperation between the city planning agencies and school districts may be achieved in this activity. The city planning directors and the school superintendents in cities having a population of 100,000 or more were surveyed by a questionnaire to determine the legal basis for cooperation between the schools and the city planning agencies, the nature and extent of existing relationships and the areas or activities in which cooperation occurred in these cities. Detailed information on the procedures followed in achieving cooperation was secured from five cities reporting successful cooperative relationships.

Legal conditions requiring the cooperation of school districts and city planning agencies were reported from 28 percent of the cities. Some of these requirements are: the referral of school building plans to the city planning agency, the school's compliance with the city's master plan, the inclusion of school buildings in the city's master plan, the school's compliance with the city's building codes, city zoning requirements and education code specifications.

Various types and degrees of participation by the city planning agencies and school authorities in the planning for school facilities were reported in the questionnaire survey. Among these, the most frequently mentioned was that of exchanging information relative to the operations of the planning agency and the schools. In 59 cities or 54 percent of those under study this type of relationship was reported. Relationships involving an exchange of information plus a more direct involvement by the city planning agency and the school authorities in the planning for school facilities were reported in 41 cities or 37 percent of those under study. The planning agencies and the school authorities in 21 cities proceeded independently of each other in their operations involving planning. In three cities the activities of the city planning agency were reported to be so limited that no effective participation could be expected of the city planning agency in the planning for school facilities.

Using the evidence available from the questionnaire survey, a summary classification of the cities under study was made. The basis for this classification was the type and extent of relationships in the planning for school facilities. More than half of the cities under study, 54 percent, were classified as reporting some cooperative relationships in the area of school facility planning. Thirty-four percent of the cities reported routine procedural relationships. And, in eleven percent of the cities, no relationships whatsoever were reported. Thus, it may be seen that participation by the city planning agency along with the school authorities in the planning for school facilities does exist in a cooperative manner in more than half of the cities and to a lesser extent in approximately another third of the 110 cities included in this study.

Successful cooperative planning practices were found to have resulted from legally established procedures, from the existence of a third or outside agency such as a priority establishing committee representative of citizens as well as government officials and from the executive branch of the city government through its planning function it chose to exercise its powers of leadership and coordination in over-all community planning involving the schools and other public and private agencies.

Microfilm \$3.55; Xerox \$12.40. 275 pages.



# AN EVALUATION OF THE SUPERINTENDENT'S CONCEPT OF AND IMPACT ON SELECTED ASPECTS OF VOCATIONAL PROGRAMS

(L. C. Card No. Mic 60-4154)

Wilmer Keith Bugher, Ph.D.  
Purdue University, 1960

Major Professor: Clarence A. Pound

The purpose of this study was to arrive at conclusions relative to the superintendents' : (1) ratings of acceptance of selected purposes of vocational programs, (2) ratings of importance of selected purposes of vocational programs, (3) responses to questions regarding vocational education and the primary role of the public school in a democratic society, (4) factors of status, and (5) influence of the foregoing items on vocational programs. The study was related to a Purdue cooperative project [No. 385 (7784)] entitled "Vocational Education in Public Schools as Related to Social, Economic and Technical Trends."

The population for the study was the superintendents of three selected size groups of Indiana public high schools. The sample was composed of 75 superintendents with 66 of the 75 participating in the study. An instrument was constructed and administered to each superintendent. The instrument contained: (1) 23 purposes of industrial education, (2) 25 purposes of vocational agriculture, (3) questions regarding vocational education and the primary role of the public school in a democratic society, and (4) statements regarding the status of the superintendents. Data were obtained from the Purdue project on the following: (1) schools' acceptance of purposes of vocational programs, (2) jury's ratings of importance of purposes of vocational programs, (3) schools' operational procedure scores of vocational programs, (4) schools' resource scores for vocational programs, and (5) salaries of teachers of vocational agriculture. Appropriate statistical tests were applied to the data.

The results of the study indicate that:

1. Superintendents generally accept most of the selected purposes as goals of their vocational programs in schools they administer.
2. Superintendents believe the accepted purposes of vocational programs should be emphasized according to the extent to which they accept these purposes.
3. Superintendents and members of the jury are substantially in agreement regarding the ratings of importance of purposes of vocational programs.
4. There is a basic lack of agreement between superintendents and teachers with regard to the acceptance of purposes of vocational programs.
5. City and county superintendents are substantially in agreement with regard to the acceptance and importance of purposes of vocational programs.
6. City and county superintendents generally are in agreement regarding: (1) the nature of vocational education; (2) the clientele of vocational education, and (3) the primary role of the public school in a democratic society; however, there was some lack of agreement regarding the importance of vocational education.
7. The vocational program scores of schools' acceptance, operational procedures, and resources are generally not affected by the superintendents' training, experience

and basic orientation with regard to the nature, clientele, and importance of vocational education and to the primary role of the public school. Although the vocational program scores of superintendents' acceptance and importance are not affected by the superintendents' training, experience, and basic orientation with regard to the primary role of the public school, they generally are affected by the superintendents' basic orientation with regard to the nature, importance, and clientele of vocational education.

8. Superintendents' acceptance scores are substantially related to the operational procedure and resource scores of vocational agriculture; and superintendents' acceptance scores have a definite but small relationship to operational procedure scores of industrial education but are not related to resource scores of industrial education.

9. Superintendents are not in agreement with: (1) the current nature of vocational education, (2) the present clientele of vocational education, (3) the present importance of vocational education, and (4) the present primary role of the public school in a democratic society.

Based on the underlying assumptions and the analysis of the data in this study, the emphasis placed by the superintendents of schools on selected aspects of vocational programs has only limited effect upon the purposes accepted by schools, the operational procedures utilized in attaining purposes, and the resources provided to facilitate the operation of vocational programs.

Microfilm \$2.50; Xerox \$8.00. 172 pages.

# THE EFFECT OF THE ELEMENTARY SCHOOL PRINCIPAL AND CERTAIN RELATED FACTORS ON PUPIL ACHIEVEMENT

(L. C. Card No. Mic 60-5420)

Gabriel Andrew Buzash, Ed.D.  
The Pennsylvania State University, 1960

The study was made to determine the effectiveness of the elementary school principal on pupil achievement as shown by the results on a standardized achievement test. It further related for the schools studied, the quality of instruction, intelligence, socio-economic status, cost of instruction, and market value to pupil achievement.

Twelve selected schools were used in this study. These twelve schools were divided into three categories. The first category included four elementary schools with a teaching principal. The second category included four elementary schools with a half time principal. The third category included four elementary schools with a full time principal.

The schools were rated on judged quality of education. The sixth grade pupils in each school were also given an intelligence test and an achievement test. The sixth grade was chosen since it was felt that the cumulative results of the principal's effectiveness on the schools would be more noticeable at this level. Only pupils who were products of the school were used.

Data were collected to determine the market value of real estate per pupil in each district, cost of the instructional program per teaching unit, and the socio-economic status of the families in the district. Those data were treated statistically to determine the possible relationship to pupil achievement.

**Findings:**

The schools studied were relatively good schools as judged by evaluative criteria. The mental ages and the grade equivalents in achievement of the pupils in the twelve different schools used were above average. The three categories of schools, however, were rather closely related in mental ability.

The achievement levels for the pupils of the different schools were treated statistically comparing means between groups. The schools of the full time principal scored 1.1 grade units above the standard level for grade six. The half time principals' schools were 1.2 grade units above standard and the teaching principals' schools were only .5 grade units above standard. A "t" test indicated significance at the 1% level for the half time principal and the full time principal when compared with the teaching principal.

The status of the parents was slightly above average in all three school areas.

The market value per pupil and the cost of instruction per teaching unit were also determined. These were both positively related to achievement. High wealth and cost seem to go with high quality of instruction.

The achievement test results by districts indicate that where a part time or a full time principal was available, the pupils did better in achievement. The schools with a teaching principal scored lowest in achievement.

**Conclusions:**

1. The schools used in the study were basically good schools as judged by evaluative criteria.
2. The achievement level of the pupils was highest in the schools where a half time principal was available.
3. The achievement was most effected by principalships, either half time or full time, but cost and wealth were supporting elements.

Microfilm \$2.50; Xerox \$5.20. 102 pages.

**THE STATUS OF MARRIED STUDENTS  
IN THE NORTH CAROLINA  
PUBLIC HIGH SCHOOLS**

(L. C. Card No. Mic 60-5983)

Lloyd Gilbert Carroll, Ed.D.  
Duke University, 1960

Supervisor: E. C. Bolmeier

**Problem, purpose, and procedure.** The fact that more boys and girls of high school age are marrying today than formerly and are remaining in school is presenting public school officials with an unusual problem.

The purpose of this study has been to determine the status of married students in the North Carolina public high schools. This has been attempted through an investigation and analysis of court decisions and legal opinions concerning the problem, an analysis of superintendents' and principals' replies to questionnaires on married students, and personal interviews and correspondence with selected school administrators.

**Summary.** During the first month of the 1959-60 school year, 482 married students were enrolled in the high schools which are included in this study. One hundred three of these students are boys and 379 of them are girls.

Ninety per cent of the married students are in the eleventh grade or higher.

Four per cent of the twelfth-grade girls in the county schools and nearly 3 per cent of the twelfth-grade girls in the city schools are married.

Eight, or 1.7 per cent, of the married students are within the compulsory school attendance age; 40, or 8.3 per cent, of them constitute married couples; and 98, or 20.3 per cent, have children of their own.

Eighty-three, or 47.7 per cent, of the superintendents and 75, or 54.7 per cent, of the principals reported that they have definite policies regarding married students. Forty-one of the superintendents and 45 of the principals said that their policies are written in the minutes of the school board.

All of the superintendents in North Carolina stated that married students are permitted to attend the schools in their districts; however, 3 of the principals reported otherwise.

Other practices which were reported by the principals include the following:

1. Forbidding married students the privilege of participating in extra-class activities.
2. Excluding married pregnant girls from the schools.
3. Requiring married couples who remain in school to attend separate schools.
4. Requiring married students within the compulsory school attendance age to attend school.
5. Requiring married students to appear before the school board in making application to remain in school.

**Conclusions.** A higher percentage of county high school students marry than do city high school students.

A high percentage of the married students drop out of school; a low percentage of them follow college preparatory programs; and a low percentage continue their education beyond high school in any type of educational institution.

Married students are not subject to compulsory school attendance laws.

School boards can not legally suspend married students from the public schools permanently on the basis of marriage alone; however, they can legally suspend married students temporarily if it can be shown that the suspension is necessary to the efficiency, progress, and management and government of the schools.

Rules and regulations which restrict the extra-class activities of married students will be held reasonable by the courts if it can be shown that the rules and regulations are essential to the welfare and progress of the schools.

The legal status of married students is the same as that of single students insofar as the right to attend the public schools is concerned.

**Recommendations.**

1. School officials should take steps to discourage unnecessary marriages among high school students.
2. There should be no restrictive policy regarding married students. In no case should there be a policy



to forbid married students the right to attend the public schools.

3. All policies regarding married students should be written in the minutes of the school board.

Microfilm \$2.95; Xerox \$10.15. 225 pages.

**THE DEVELOPMENT AND EVALUATION  
OF A LEADERSHIP ATTITUDE SCALE  
AROUND THE INTERPERSONAL  
RELATIONS ROLE OF THE  
ELEMENTARY SCHOOL PRINCIPAL**

(L. C. Card No. Mic 60-4712)

Vincent James DiNardo, Ed.D.  
Boston University School of Education, 1960

**1. Problem**

This study attempted to develop and evaluate a leadership attitude scale around the interpersonal relations role of the elementary school principal.

**2. Procedure**

From a review of the research and literature relative to the nature and number of tasks involved in administering an elementary school, it was determined that more than two-thirds of the duties performed by the principal involved face-to-face relationships with people. These people fall into seven categories: (1) teachers; (2) pupils; (3) peers; (4) superintendent; (5) non-educational personnel; (6) parents of pupils; (7) community representatives.

A representative sample of these duties was selected for use in developing an attitude scale which would reflect the principal's attitudes toward these relationships. In the preliminary form of the scale, 22 job-problem situations were selected. Each problem situation was offered with four alternative solutions reflecting different styles of leadership behavior in interpersonal relationships.

Using Thurstone's method of paired comparisons and a forced-choice technique, six scale items were developed for each of the 22 job situations, resulting in a preliminary scale of 132 randomly distributed items. The scoring procedure provided total scores in each of the four styles of leadership. After a preliminary administration of the scale to 52 principals, the poorer items were rewritten or deleted. The revised scale was administered to 135 supervising principals, representing 90 per cent of the principals in Plymouth and Norfolk Counties in Massachusetts. The revised scale contained 108 items. The data provided by the scale included scores for each leadership style as well as personal and situational data regarding sex, age group, number of schools and teachers supervised, length of experience as principal, amount of clerical help provided and level of education completed.

In the validating procedure, 15 judges classified the scale items in accordance with definitions and rationale provided them. This group included principals, graduate students in administration, and professors of education. Four judges, experts in human relations, school administration, and educational philosophy, performed the same task, but were given no definitions or knowledge of the investigator's rationale. Thus, an index of agreement was obtained.

As a further validation technique, a 27 per cent sample of those respondents who scored at least one standard deviation above the mean score in each style of leadership, was selected for follow-up study. An evaluation of the style of interpersonal relations behavior manifested on the job by each respondent was obtained from a co-worker.

**3. Summary and Conclusions**

An 83 per cent agreement was obtained by qualified judges with definitions, while those without definitions attained a 63 per cent agreement, indicating both groups were able to recognize and classify the items substantially in accordance with the styles of behavior the scale was designed to reflect.

Chi square tests of the distributions of the actual scores and the observed scores produced p-scores of .13, .36, and .78, indicating that stereotypes concerning attitudes were overcome in three of the four leadership styles. For stations A, B, C, and D on the hypothesized continuum, the following correlations were computed:  $r_{AB} = -.09$ ,  $r_{AC} = -.49$ ,  $r_{AD} = -.65$ ,  $r_{BC} = -.18$ ,  $r_{BD} = -.49$ ,  $r_{CD} = -.01$ , indicating the existence of the continuum.

A validity coefficient of plus .62 indicated that the scores made by the principals on the scale were substantially related to the evaluations of the principals' attitudes on the job as made by co-workers.

Investigation of some personal and organizational correlates of principals' attitudes showed few significant relationships. Some basis exists for the belief that older principals, women principals and principals with minimal levels of professional training, show a greater preference for the authoritative style of leadership.

Microfilm \$4.05; Xerox \$14.20. 313 pages.

**THE EFFECT OF KINDERGARTEN  
EXPERIENCE UPON ACADEMIC  
ACHIEVEMENT IN THE ELEMENTARY  
SCHOOL GRADES**

(L. C. Card No. Mic 60-5232)

Leeman Everett Haines, Ph.D.  
The University of Connecticut, 1960

**The Problem**--The purpose of this study was to determine the effect of kindergarten experience upon academic achievement in the elementary school grades. The study confined itself to the academic areas of reading and arithmetic.

**Sources of Data and Procedure**--Data for this study were gathered in the towns of Griswold and Plainfield, Connecticut. These two communities were selected for the study because after exhaustive study they were determined to be as nearly alike as could be found in the state while still meeting the requirements of only one of them offering public school kindergarten experience. Griswold provides kindergarten experience while Plainfield does not. The two communities are located in the eastern, rural section of Connecticut and are nearly the same size. They share a common boundary with Plainfield being just to the north of Griswold. Both communities are located on rivers with water power potential; and their early development and

historical problems closely parallel the development of the textile industry in Connecticut.

The Pintner series of General Abilities Tests was administered to all children, in both communities, in grades one through six. The same children were tested in the areas of arithmetic and reading with the Metropolitan Achievement Tests. Since the data were gathered in the fall of the year the Metropolitan Readiness Test was used in grade one. There were 811 children who completed all tests. Results were tabulated and mathematical computations made to determine the comparability of the two groups.

It was found that the children in Griswold, where kindergarten experience was provided, measured enough higher in mental ability to make it impossible to consider the groups as comparable. Therefore, matched groups were set up whose mean intelligence scores and mean ages were nearly identical. This procedure reduced the number of cases on which conclusions were drawn to 603 cases.

**Conclusions--**Final analysis of the matched groups data indicates the following conclusions:

1. While reading scores of the group having had kindergarten experience were consistently higher than those without kindergarten experience the differences are not great enough to be statistically significant. In other words, with the population used in this study, kindergarten experience had no significant effect upon reading achievement in any grade.
2. While arithmetic scores of the group having had kindergarten experience were consistently higher than those without such experience the difference was statistically significant only in grades two and five. In these two grades the difference was significant beyond the one per cent level of confidence.
3. Academic advantages accruing from kindergarten experience are more pronounced in the area of arithmetic than in reading.

Microfilm \$3.40; Xerox \$11.95. 262 pages.

**AN OBJECTIVE ANALYSIS OF THE POTENTIALS  
FOR SCHOOL DISTRICT REORGANIZATION  
IN A NINETEEN-COUNTY AREA OF  
SOUTHEAST TEXAS**

(L. C. Card No. Mic 60-5379)

Wallace Charles Hill, Ed.D.  
University of Houston, 1960

**Problem.** The problem investigated in this study was to develop a program of school district reorganization applicable to districts within a nineteen-county area of southeast Texas, and to show what differences such a reorganization would make possible with respect to the following factors: tax structure, economy of operation, curriculum development, professional staffing, and potentials applicable to physical assets.

**Procedures.** Statistical data were compiled concerning the problem. The information thus secured was related to each school district by counties and by county groups. Harris County was used as the point of geographical reference. The densely populated and heavily industrialized counties were considered apart from those denominated as "outlying."

Maps of each of the nineteen counties were produced. Existing school district boundaries were shown in each county. Symbols were used to denote the extent of educational opportunities offered by race and by grade.

A second set of maps was then prepared to show the boundaries of each school district that would result from the reorganization proposal. Educational opportunities proposed were denoted by symbols for race and grade. Comparisons were made of the differences prevalent in the educational characteristics of the districts before and after reorganization.

There are 149 school districts of varying size and characteristics in the nineteen-county area. Reorganization proposals for illustrative purposes would reduce this number to forty-three independent school districts.

The study does not deal with the problems involved in racial integration. Reorganization proposals are made in accordance with Texas law, which now mandates segregation. In a few instances Negro scholastics have been attached to adjoining districts to secure greater student participation. In two instances cooperative Negro educational centers are considered necessary, assuming continuance of segregation, to secure apparent advantages of greater student participation.

Negro educational opportunities are limited in most of the area due to a sparsity of Negro population which necessarily limits the number of Negro scholastics. One county and one school district have undergone integration to some degree. Calhoun County Unit has integrated its secondary schools. Victoria Independent School District allows integration on a voluntary basis.

**Findings.** Certain counties showed evidences of deliberately holding tax values to a low level. Invariably these counties had the highest incidence of small and poorly organized school districts.

A concentration of greater numbers of students in the emerging new districts can be considered a basis upon which curriculum will evolve.

More specialists and a more efficient assignment of professional personnel generally accrue to larger districts.

The industrialized counties reveal less dramatic gains in the field of curriculum development and the addition of teaching specialists due to heavy population and large school systems already established.

Reorganization produces a broader tax base upon which an emerging district may plan its future operations.

Reorganization does not, however, necessarily mean a cheaper operation as far as money spent is concerned; better and additional services cost correspondingly additional amounts of money.

**Implications.** This survey and the resultant reorganization proposals have indicated a three-fold requisite for effective school district reorganization.

A scientific system of tax assessment should be instituted to alleviate the confused fiscal status of many of the existing districts. Such a system must be designed to



produce adequate revenue in an equitable and impersonal fashion, without regard to tradition, emotionalism, or the selfish wishes of influential taxpayers.

Scientific and objective analysis of local conditions, followed by vigorous local leadership, should lead individual communities into reorganization planning.

Existing state laws are in need of revision, especially with regard to the role of the Texas Education Agency in assisting with reorganization planning and extending financial inducements for more effectively organized districts.

Microfilm \$4.45; Xerox \$15.55. 345 pages.

**COMPARISON OF BELIEFS OF ELEMENTARY  
SCHOOL PRINCIPALS CONCERNING JOB  
EXPECTATIONS OF INEXPERIENCED  
TEACHERS WITH REPORTED  
EXPECTATIONS OF INEXPERIENCED  
TEACHERS IN CONNECTICUT**

(L. C. Card No. Mic 60-5238)

Sophie Landeck Jenkins, Ph.D.  
The University of Connecticut, 1960

The purpose of this study is to discover significant differences between what principals believe inexperienced teachers look for, and what inexperienced teachers really look for in a teaching position.

Information concerning the beliefs of 275 students preparing to teach in elementary schools was obtained from the Bureau of Research and Statistics, State Department of Education, Hartford, Connecticut. Information as to the beliefs of principals concerning the expectations of inexperienced teachers was obtained from questionnaires completed by a ten per cent random sampling of elementary school principals. The questionnaire for principals was the same as the student questionnaire used by the Bureau of Research and Statistics.

The statistical measure used for describing group differences was critical ratio. Probability of chance occurrence was used to indicate statistical difference at the .01 and .001 levels of confidence.

Principals overestimate the importance inexperienced teachers place on five items, or four per cent of the total. Principals underestimate the importance inexperienced teachers place on eighty-one items, or sixty-eight per cent. There were no significant differences between the responses of principals and inexperienced teachers on thirty-three items, or twenty-eight per cent.

Principals do not accurately assess value judgments of inexperienced teachers regarding the importance of supervision, participation in policy making, opportunities for professional growth, philosophy, orientation, functions of boards of education, aspects of the community.

It is recommended that programs preparing teachers:

1. Provide information concerning principles involved in developing teacher personnel policies.
2. Provide information about the legal status and functions of boards of education, and sources of financial support for public education.
3. Emphasize the role of the teacher in curriculum development.

4. Promote a deeper understanding of the dynamics of community life.

5. Improve communication between school personnel and prospective teachers by facilitating the exchange of ideas on the role of the beginning teacher.

6. Provide opportunities for school personnel, including beginning teachers who are graduates of the institution, to assist in the evaluation and development of the teacher preparation program.

It is recommended that programs preparing elementary principals:

1. Develop admissions and selections procedures capable of evaluating students on the basis of factors pertinent to performance on the job.
2. Provide internship programs and problem seminars.
3. Emphasize the development of skills in interviewing, planning orientation programs, and supervision.
4. Provide for participation of principals in evaluation and development of programs preparing principals.

It is recommended that boards of education and their administrators:

1. Provide for participation of principals in interviewing candidates for teaching.
2. Develop effective orientation programs.
3. Support stronger supervisory and guidance services.
4. Involve beginning teachers in the development of teacher personnel policies and curriculum.
5. Recognize and encourage professional growth.

Microfilm \$2.50; Xerox \$5.20. 103 pages.

**THE EFFECT OF VARIED SUBJECT  
PERIOD SCHEDULING ON ACHIEVEMENT  
IN THE SEVENTH GRADE**

(L. C. Card No. Mic 60-5443)

Walter Alexander Kearney, Ed.D.  
The Pennsylvania State University, 1960

The purpose of this study was to make a comparison of the achievement of various ability groups of seventh grade junior high school pupils in language arts, social studies, mathematics and science taught in two different weekly time allotments: (1) the traditional or usual daily meetings of each subject area and (2) meetings of longer periods of time but fewer times per week.

The main interest was achievement expressed in mean gains as measured by a test battery. One test battery was administered in September and the other battery was administered the following May. The normal growth during the time between the two testing periods as expressed by the test makers was eight months.

Two junior high schools in the same city were used, one as the control group and the other as the experimental group.

With the control group the traditional method of the use of time was used; that is, mathematics classes were taught one period per day each day of the week, language arts classes met two periods per day each day of the week and so on. With the experimental group longer periods of time

were spent in each meeting of a class but fewer meetings per week. For example: mathematics was taught for three consecutive periods one day and for two consecutive periods on another day of the week; language arts was taught three consecutive periods one day, four consecutive periods on another day and three consecutive periods on a third day of the week. In all subject areas the same amount of time was spent in each week in each group, control or experimental.

The four track program had been introduced in both schools several years before this experiment was conducted. Only tracks one, two and three were used in this study. There was a significant gain in the test results for all tracks. In the analysis of variance study of a random sample the track variable was highly significant.

The subject areas for which scores were obtained were: reading average, spelling, language, arithmetic average, science, social studies, and study skills. Grade equivalent was also determined from each test battery.

In very few instances was mean growth less than the expected eight months in either the experimental group or the control group.

The control group was not significantly superior in any areas but had a slight advantage in reading average. In science the results were even with a slight advantage for the experimental group. In spelling and language the experimental group held an advantage which was significant in several instances. In social studies the experimental group was significantly superior. The superiority of the experimental group was highly significant in arithmetic average, study skills, and grade equivalent.

In seven of the eight areas in which the study was concerned the experimental group proved superior. The data collected demonstrate that by teaching the subjects concerned in longer periods of time fewer times per week and in performance tracks the achievement of most students will be greater than by teaching these same subjects in the traditional manner of daily meetings such as they are now taught in most junior high schools.

Naturally there are many problems which occur as a result of initiating a new method, one of which is that the mechanics of scheduling are rather difficult when the entire school is not on a program of this sort. However, enough has been demonstrated to say that the experiment was successful and that achievement was greater in the experimental group.

Microfilm \$2.50; Xerox \$3.00. 58 pages.

#### AN ANALYSIS OF ATTITUDES TOWARD THE PUBLIC SCHOOLS

(L. C. Card No. Mic 60-5396)

William Douglas Knill, Ed.D.  
University of Oregon, 1960

Adviser: Donald E. Tope

This study attempts to investigate the forces which shape certain community attitudes toward the public school system. Three very broad hypotheses are stated and provide the general framework upon which the study is constructed. These hypotheses are: (1) Attitudes toward the

public schools are a function of an individual's socio-economic position. (2) The citizens who relate themselves positively to their community, and participate in community and school affairs, will express favorable attitudes toward the schools. (3) Attitudes toward the schools are related to other attitudinal and personality characteristics.

The research design was planned as part of a larger survey undertaken by The Institute for Community Studies in the summer of 1959. The Eugene-Springfield Metropolitan area was chosen as the site for the survey and 1,500 householders were chosen by probability sampling methods to be interviewed. There were 1,230 schedules completed (an 82 per cent return) and 734 "personality inventories" returned by mail (a 60 per cent return). Each inventory was identified by number and upon return attached to the respondent's schedule. The data were kept separate by geographical area for purposes of other studies, but for the purposes of this study the respondents of the total metropolitan area were taken as a single sample.

The pivotal instrument used in the study is a four-item scale which is termed the C Scale. The four items which we define as measuring censorious attitudes toward the public schools are:

Public schools change too many children away from their parents' ideas.

There is too much emphasis on cooperation in our public schools and not enough emphasis on competition.

The public schools are not teaching the fundamentals as well today as they used to.

Nowadays children get pampered too much in the public schools.

Using the Guttman scaling technique, the responses were found to scale with a coefficient of reproducibility of 93.46 per cent. A chapter is devoted to a description of the scaling technique and illustrated by explaining the construction of the C Scale. This scale permits the categorization of the sample into five groups ranging on an attitude continuum from those who are extremely censorious to those who are supportive of the public schools.

Certain demographic variables are found to be related to C Scale scores, but no single variable has a high relationship. Age, education, occupation, and income appear to have the highest relationships. Attitudes as measured by the C Scale are related to other attitudes the public have about their schools and other community organizations.

Relationships were found to exist between the C Scale scores and scores earned on other attitude measuring scales such as the Political Efficacy Scale, the F Scale, and the Administrative Autonomy Scale. Stronger relationships are obtained when the scales are used jointly or with such demographic variables as age or education.

Sufficient data were received from the CPEA centers at Harvard University and Stanford University reporting on two studies conducted on citizen attitudes toward the schools to permit a comparison to be made of three cities of comparable size: Redwood City, California; Bay City, Massachusetts; and Eugene, Oregon. An attempt was made to find the commonalities of the three studies.

The study concludes under the heading of "Theoretical Suppositions" which provides the opportunity to generalize from the findings, and theorize about the inter-relationships and the dynamics involved.

Microfilm \$2.85; Xerox \$9.90. 217 pages.



**A STUDY OF THE ACADEMIC  
BACKGROUNDS, PROFESSIONAL  
EXPERIENCES, AND ADMINISTRATIVE  
DUTIES OF TEXAS PUBLIC JUNIOR  
COLLEGE ADMINISTRATORS.**

(L. C. Card No. Mic 60-5267)

Harold Fochone Landrith, Ed.D.  
University of Houston, 1960

**Purpose of the Study.** One of the purposes of this study was to discover the administrative duties performed by Texas public junior college administrators and to analyze the allocation of duties in junior colleges arranged in four student enrollment categories. A second purpose was to determine whether the academic backgrounds and professional experiences of Texas public junior college administrators provided a good educational basis for junior college administration.

**Procedures and Sources of Data.** Data utilized in this study were obtained from personal visits to twenty-eight Texas public junior colleges, professional literature in the field, catalogues, bulletins, and administrative handbooks from Texas public junior colleges, questionnaires submitted in person by the investigator, and private interviews with one hundred twenty-nine Texas public junior college administrators.

Two questionnaires were submitted to each administrator. One contained questions dealing with the assignment and allocation of administrative duties. A different questionnaire was constructed for each of eleven administrative positions.

The second inquiry sheet included a series of questions designed to obtain information on the academic backgrounds and professional experiences of each administrator. Both of these questionnaires were completed by the investigator during private interviews with each junior college official.

One hundred twenty-nine administrators in twenty-eight Texas public junior colleges were interviewed. The results were tabulated and analyzed, and comprehensive lists of duties for eleven administrative positions were constructed. These lists were combined into a master list in order to indicate the allocation of duties within institutions of different student enrollments.

**Conclusions.** Some of the most important findings of this study are:

1. Relatively little research has been conducted on Texas public junior college administration.
  - a. Private junior colleges in Texas were among the first in the United States to incorporate the junior college principle.
  - b. Texas public junior colleges have tended to emphasize the transfer function of two-year institutions.
2. Texas public junior college organizational patterns have been influenced by both external and internal factors. Analysis of state laws dealing with public junior colleges and data on organizational patterns revealed that:

- a. Except for restrictions placed on public junior colleges by the state legislature and the general control exercised by the State Board of Education, public junior colleges have been left free to organize and operate as their local boards of trustees prescribe.
  - b. Type of control and the relationship between the junior college and the local public school system have affected the organization of the junior college.
  - c. Size of student enrollment and availability of funds have been partially responsible for determining the organizational patterns of Texas public junior colleges.
3. Duties in Texas public junior colleges are not allocated for maximum efficiency. Results of the analysis of interviews with one hundred twenty-nine Texas public junior college administrators indicated the following:
- a. Thirty-eight different administrative titles are used in Texas public junior colleges.
  - b. Relatively few Texas public junior colleges have surveyed positions, made duty analyses, and assigned duties according to an organized plan.
  - c. All of the Texas public junior colleges except one employ a president as the chief administrator.
4. Texas public junior college administrators are moderately well trained to perform their assigned duties. Survey of the academic backgrounds and professional experiences showed that:
- a. Fifty-four per cent of the one hundred twenty-nine administrators have had formal training in junior college administration.
  - b. Sixty-one per cent had junior college experience prior to assuming their current positions.
  - c. Twenty-five per cent of the administrators gained their junior college experience in the institution in which they are currently employed.
  - d. Forty-one per cent of the administrators have had public school administrative experience.
  - e. Pre-service and in-service-training programs have been developed by relatively few Texas public junior colleges.
  - f. Ten per cent of the administrators have completed courses pertinent to their positions since receiving their current appointments.

Microfilm \$3.50; Xerox \$12.40. 272 pages.

# A PROPOSED SYSTEM OF PUBLIC SCHOOL FINANCIAL ACCOUNTING FOR NEW MEXICO

(L. C. Card No. Mic 60-4940)

LaMoine Langston, Ed.D.  
The University of New Mexico, 1960

The purpose of this study was to develop a system of financial accounting that would conform to sound, accepted principles and would not violate the statutory provisions governing financial accounting for public schools in New Mexico. Public school accounting practices in New Mexico make it difficult to secure information concerning financial transactions which would enable school administrators or the general public to determine the cost of performing various educational functions, the amounts and sources of revenue available to support these functions, or the nature, the value, and the condition of physical assets available for support of the various functions.

The method of procedure was to abstract from the literature school financial accounting principles generally accepted as being sound. The factors affecting the financial accounting for schools in New Mexico were examined, pointing out the areas in which the system was weak; and steps were taken to correct the weaknesses of the old and to add needed provisions in the development of a new proposed system that would conform to the sound principles as abstracted from the literature.

The budgets of all the public schools of New Mexico, as approved for 1957-58, were studied. A great lack of uniformity in budgetary practices in the state was found. It was clearly shown that there had been no development of uniform accounting terminology on the state level for use by local school districts. There was no consistency in the classification of line items in the budgets examined. Such diversity in the budgetary process, it was noted, resulted in equal diversity in the accounting procedures.

A jury of nine school administrators was selected to evaluate the importance of the eleven principles of accounting abstracted from the literature as they might be applied to New Mexico practices in public schools. The jury also evaluated the over-all system of financial accounting for public schools practiced in New Mexico.

An analysis of the accounting practices in New Mexico revealed that only three of the eleven principles abstracted from the literature were being followed. The analysis also showed that certain statutory changes must be made before full compliance with accepted principles could be achieved. The chief deficiencies of the New Mexico system of financial accounting for public schools were found to be (a) inadequate accounting for receipts, (b) improper classification of expenditure accounts, (c) inadequate accounting for property and stores, (d) a lack of the use of clearing accounts, (e) insufficient cost accounting, and (f) a lack of uniformity of terminology.

The system of accounting developed for New Mexico in this study should correct all the deficiencies found to exist, and should make possible the submission of reports to the U. S. Office of Education directly from the State Department of Education of New Mexico. Required reporting forms of the U. S. Office of Education were considered as the study was being made.

In the development of the accounting system for New Mexico, each of the eleven principles used as criteria for

a sound system of accounting was observed. The study pointed out how each principle was complied with as the accounting system was developed. The statutory changes necessary for a full compliance with accepted principles of financial accounting for schools were noted.

The study recommended that the State Department of Education in New Mexico, in cooperation with the Chief of the Division of Public School Finance, take steps to see that the New Mexico public schools change the present system of financial accounting to conform to the plan suggested in the study, or another that would meet the same criteria. It was further recommended that a handbook of instructions be developed to assist administrators in following the system that is adopted. It was recommended that statutory provisions be adopted to allow easier legal compliance with a sound system of financial accounting for the public schools. The study recommended that institutions of higher learning in New Mexico offering course credit in school administration should be urged to include work in school financial accounting. The final recommendation was that the entire area of school business management in New Mexico be studied toward the end of achieving better business practices.

Microfilm \$2.70; Xerox \$9.45. 207 pages.

# SCHOOL PROPERTY INSURANCE IN TEXAS

(L. C. Card No. Mic 60-4551)

Frank Powell Leathers, Ph.D.  
The University of Texas, 1960

Supervisor: Dr. Kenneth E. McIntyre

The purpose of this study was to investigate the school property insurance practices in Texas to determine how they may be improved at both the state and local levels. As background for this study, similar studies made in other states and other literature on the subject were reviewed, and questionnaires were sent to the fifty state departments of insurance. Thirty-three of these questionnaires were returned. The main text of the study was based on data collected by means of a questionnaire sent to every twelve-grade school system in the state. The questionnaire was prepared by the writer, through sponsorship of the Texas Association of School Boards. Of the 1,061 questionnaires sent, 485, or 46 per cent, were returned.

Thirty-two conclusions were reached at the end of the study. The most significant of these are as follows:

1. An increased interest in school property insurance has developed over the nation during the last decade.
2. A number of states have provisions which indicate that their local school systems are permitted to purchase school property insurance more economically than school systems in Texas are permitted to do.
3. The school property insurance practices as reported by Texas school administrators are sound.



4. A small percentage of the school systems studied take bids on their insurance or insure with deviating companies.
5. School buildings and contents of the school systems studied are adequately covered with insurance.
6. School systems in Texas are having to pay too much for their insurance.
7. A majority of school officials in Texas favor a state-operated school property insurance fund.

Recommendations were presented in two categories, one for improvement at the state level and the other at the local level. The recommendations for improvements at the state level are as follows:

1. Establish a separate classification for fireproof and semi-fireproof school buildings.
2. Continue to gather data on school property insurance over the state.
3. Furnish consultants to assist local school systems in improving their insurance programs.
4. Make it possible for mutual insurance companies to write insurance on school buildings.
5. Improve safety and fire prevention programs.
6. Require insurance agents to make thorough initial and follow-up inspections when insuring a school building.
7. Study the desirability of establishing a state-operated school property insurance fund.

Recommendations for improvements at the local level are as follows:

1. The local board of education should establish policies and then delegate the responsibility for administering the local insurance program to an administrator.
2. The person responsible for the local program should study the technical aspects of property insurance.
3. The local school officials should use professional appraisers to establish values.
4. The blanket or schedule policy plan is recommended for school systems with similarly constructed buildings.
5. The local board of education should consider awarding school insurance to the local insurance agents' association.
6. The local school administration should arrange the school property insurance program so that annual premiums will be approximately equal.
7. The local school authorities should keep systematic insurance and inventory records. They should be stored in a safe place.
8. Local school officials should study the rate analysis sheets and have the buildings inspected frequently.
9. The school authorities should have a plan to be followed in the event of a loss.

10. The school administration should award school property insurance on the basis of coverage, quality of service, and cost, disregarding any grants, awards, or other returns to the school program (such as financing scholarships, driver education programs, and athletic programs) from the agent awarded the insurance.
11. The local school system officials should familiarize themselves with state-operated school insurance plans.

Microfilm \$4.55; Xerox \$16.00. 354 pages.

# AN INVESTIGATION OF CURRENT ADMINISTRATIVE AND SUPERVISORY PRACTICES AND PROBLEMS IN LARGE ELEMENTARY SCHOOLS IN IOWA

(L. C. Card No. Mic 60-5674)

Donald Bryce Lindsay, Ph.D.  
State University of Iowa, 1960

Co-chairmen: Associate Professor Jerry N. Kuhn  
Professor Herbert F. Spitzer

This study was undertaken to determine whether a single administrative official, the principal, can adequately deal with the administrative, supervisory, and curricular tasks involved in large elementary schools; to determine whether assistance to the principal seems warranted; and to determine whether the assignment of an assistant principal represents an adequate solution to the problem of increased administrative responsibility. An additional purpose was to identify and describe administrative and supervisory practices which have been found to be effective in the cooperating schools in the study.

The directors of elementary education and twenty-six elementary school principals in six school systems distributed geographically throughout Iowa were interviewed using a fifty-seven item questionnaire as an interview guide. The interviews were recorded on a tape recorder.

The principals were asked to submit the same questionnaire to the teachers in their buildings. Fifty-seven activities of the elementary school categorized under (a) organization and administration, (b) supervision, (c) pupil personnel, (d) clerical, (e) teaching, and (f) community relationships, were used as items on the questionnaire. The respondents were asked to indicate the position(s) of the person(s) now performing each of the activities, the position(s) of the person(s) who should perform the activity under ideal conditions of organization, and to indicate whether or not the activity was currently being performed satisfactorily. Clarification of responses through comments was encouraged.

The results of the study seem to support the following conclusions:

1. There are no elementary schools in Iowa where a full time assistant principal is assigned. Three school systems in the state assign assistant principals with part time or full time teaching loads.
2. Based upon the experience in the system which assigns half time assistant principals it seems safe to

conclude that the assignment of an assistant principal to a school does in fact relieve the principal of much detail and enables him to improve the supervision in the school.

3. Half time assistant principals can be justified in all large elementary schools. Full time assistant principals can be justified in elementary schools with extra administrative and supervisory loads.

4. The administrative procedures which represented the best current practice were those which had been routinized and delegated to others so as to require a minimum time involvement for principals and teachers.

5. The supervisory practices which were judged to be outstanding were those (a) in which teachers were involved in all phases of planning and conducting in-service training activities, in maintaining communications between teachers and supervisory personnel at all levels, and in evaluating outcomes, (b) in which relief was provided for teachers during the school day for purposes of holding supervisory conferences or to allow the teacher to visit other teachers in action, (c) in which small groups of teachers were brought together to work out solutions to common problems, and (d) where specific help was provided to teachers in the form of guides to planning and the services of educational consultants.

6. There are a number of administrative practices in some of the cooperating schools which are questionable but which could be improved by reassignment of responsibility or by addition of more personnel. Briefly stated these practices fall into two categories: (a) lack of a systematic plan for communicating to teachers basic information concerning administrative responsibilities and (b) failure to routinize and delegate responsibility for activities which are of a recurring nature.

7. Supervisory practices in some areas are not operating satisfactorily in some of the cooperating schools but probably could be improved by assigning additional personnel or by reassignment of responsibility. These practices fit into two general categories: (a) lack of a systematic procedure for explaining to teachers the system-wide allocation of job responsibilities and (b) lack of sufficient personnel to accomplish many of the supervisory tasks existent in large elementary schools.

Microfilm \$3.40; Xerox \$11.95. 261 pages.

#### A COMPARISON OF EXPECTATIONS OF THE SUPERINTENDENT'S EXERCISE OF SOCIAL POWER IN THE STATE OF MINNESOTA

(L. C. Card No. Mic 60-5605)

Patrick Daniel Lynch, Ph.D.  
University of Minnesota, 1960

Advisers: Otto E. Domian and E. Paul Torrance

That superintendents and school board members have widely differing expectations of the superintendent's role has been established by Sletten, Gross and associates, and Garafalo, among others. Superintendents presumably

derive many concepts of their role from professors of educational administration. This study investigated the problem of whether board members in the State of Minnesota differ from professors of educational administration on the superintendent's role.

Role was approached in this study from the aspect of exercise of social power in the school system. Five hypotheses were tested for significant differences between board members and professors in their expectation of the superintendent's exercise of expert, referent, coercive, legitimate, and reward powers. These bases of social power were defined by French and Raven.

Board members' expectations of the superintendent's exercise of social power were hypothesized for differences according to six regions of the state and three sizes of community. The chi square test of significance was used for all seven hypotheses.

A questionnaire constructed by the author was sent to ten per cent of board members of districts offering at least twelve years of education in Minnesota, sampled according to size of community and region of the state, and professors of educational administration in nine upper Midwestern universities. Ninety-five per cent of board members and eighty per cent of professors returned questionnaires.

Board members and professors differed significantly on ten of fifteen items concerning the superintendent's expert powers. Board members tended to place more importance upon specific types of administrator experience while professors tended to place more importance upon academic preparation, intelligence, and professional affiliation.

Disagreement was significant on sixteen of the nineteen items concerning the superintendent's exercise of referent power. Professors were more inclined to have the superintendent bring together citizens and the board to study school problems, while board members were more concerned that superintendents observe local customs.

The superintendent's exercise of coercive power was viewed differently in seven out of nine cases. Board members looked more favorably upon the superintendent's exercise of this kind of power.

Significant differences appeared in ten out of thirteen cases concerning the superintendent's exercise of legitimate power. Professors viewed as desirable the superintendent's exercise of power in many different directions, while board members viewed his position as more strictly that of executive officer, carrying out only stated policy. Board members felt strongly it was undesirable that superintendents influence policy making.

In seven out of eight items concerning the superintendent's exercise of reward power, differences were significant. Board members were inclined to limit the superintendent's exercise of this kind of power.

There was little evidence that board members differed in their expectations according to region or size of community.

Board members were far less concerned than were professors that the superintendent maintain identification with his staff, and they felt that the superintendent should apply coercion more often than professors felt it desirable. As the superintendent exercises broader legitimate and reward powers, board members may feel their positions are weakened.

Both groups agreed that the superintendent's main



concern should be classroom instruction and that curriculum improvement is his most important task. There is little excuse for a superintendent in Minnesota to claim that the board does not expect this kind of educational leadership of him.

Minnesota board members disagreed greatly with the superintendent's role as viewed by professors of educational administration. Either board members must be educated to role concepts held by professors of school administration or professors must examine and modify their concepts. Role concepts held by board members should be examined so that the administrator is prepared to meet board member role expectations different from those held by the professors.

Microfilm \$3.35; Xerox \$11.70. 258 pages.

# AN ANALYSIS OF PROBLEMS IN THE ADMINISTRATION OF SPECIAL EDUCATION PROGRAMS IN CONNECTICUT

(L. C. Card No. Mic 60-5248)

Joseph Bernard Porter, Ph.D.  
The University of Connecticut, 1960

The purpose of this study was to analyze the program for meeting the needs of children in the public schools of Connecticut who are physically handicapped, mentally handicapped or speech defective.

Practices affecting programs for handicapped children in the United States were investigated by contacting chief state school officers in forty-nine states and requesting information concerning regulations and policies in meeting the needs of these atypical children. Information was received from forty-eight of the forty-nine states, representing returns of ninety-eight percent.

Information on basic needs, problems and adequacy of programs as determined by the school superintendents of Connecticut was obtained by sending a questionnaire to all one hundred fourteen such superintendents. Ninety-seven questionnaires were returned representing eighty-five percent of the Connecticut superintendents of schools.

The United States Office of Education was contacted by writing to the United States Commissioner of Education requesting information on recommended practices of state departments of education in meeting the needs of handicapped children. A letter was received from the Commissioner outlining some general practices in the States for meeting the needs of these children, but no recommendations were forthcoming.

In all states a legal framework existed for the operation of special programs for handicapped children, and permissive legislation was the more common. Most states had established regulations relative to class size and criteria for entrance into special programs. Also, most states helped to finance local programs and offered consultative services to local communities. Certification requirements for teachers and supervisors of special education was common practice in the States. Direct rather than consultative services by state departments of education was not common practice.

Connecticut regulations at the time of the study were generally in accord with regulations as practiced by a majority of the states.

The superintendents of schools in Connecticut felt that special education was the responsibility of local and state government and the cost should not be assumed by the federal government. They indicated that lack of building space, teachers, and adequate financing were major problems in establishing local programs. The superintendents also felt a need for clarification of regulations affecting handicapped children. Programs for the physically handicapped were deemed adequate, with only mild agreement expressed on the adequacy of programs involving the educable mentally handicapped. There was divided feeling on the adequacy of programs for the trainable mentally handicapped, and strong feeling that speech correction programs were inadequate. Superintendents were not sure that the local community should be responsible for the trainable mentally handicapped youth.

Communities with pupil populations of less than 2,500 experienced the most difficulty in meeting the needs of mentally handicapped and speech defective children. There was agreement that regionalization should be considered as a promising method for assisting these communities.

Present Connecticut policies prohibiting the payment by towns for the education of handicapped children hospitalized out-of-state should be revised, according to the superintendents of schools in Connecticut.

Other major conclusions were: the State of Connecticut could do more to meet the needs of children who are mentally handicapped or who have speech defects; the United States Office of Education assumes little leadership in the development of programs for meeting the needs of handicapped children, and, the Connecticut State Department of Education should assume a larger leadership role in helping local communities in solving the problems and clarifying the needs of handicapped children.

Microfilm \$2.50; Xerox \$7.40. 160 pages.

# A STUDY OF THE ADMINISTRATION OF PUPIL PERSONNEL SERVICES IN SELECTED NORTH CAROLINA CITY SCHOOL SYSTEMS

(L. C. Card No. Mic 60-4861)

Richard Shaw Ray, Ed.D.  
The University of North Carolina, 1960

Supervisor: Guy Berryman Phillips

This study is one in a series of eight studies being undertaken at the School of Education of the University of North Carolina in connection with the Southern States Cooperative Program in Educational Administration.

In 1955 the SSCPEA issued a publication entitled Better Teaching in School Administration. In this publication eight critical task areas were identified in school administration, one of which was pupil personnel administration. The report described the activities which school administrators need to perform in each of the critical task areas. The eight critical task areas and the activities in each formed a Competency Pattern for educational administration. A project was set up at the University of North Carolina to relate the Competency Pattern to the actual administration of the public schools in North Carolina.

It was the purpose of the current study to determine the

responsibilities which superintendents and other school personnel in certain North Carolina city school systems have for administering pupil personnel services, to study ways in which situational factors affect the administration of pupil personnel services, and also to draw from the findings implications for the pre-service and in-service training of school administrators.

Twelve critical tasks performed by school administrators in pupil personnel administration were identified. These tasks were:

1. Initiating and maintaining a system of child accounting and attendance.
2. Providing school health services.
3. Instituting measures for the orientation of pupils.
4. Providing counseling services.
5. Providing individual inventory services.
6. Providing occupational and educational information services.
7. Providing placement and follow-up services.
8. Arranging procedures for the assessment and interpretation of pupil growth.
9. Establishing means of dealing with pupil irregularities.
10. Developing and coordinating pupil activity programs.
11. Providing for the needs of exceptional children.
12. Coordinating school and community agencies.

Six city school systems of varying sizes were selected as sites for the study. Information was obtained in each school system through the use of a structured interview with the superintendent, questionnaire responses of administrative, supervisory, and instructional personnel, printed materials, and the personal observation of the writer. A period of from three to five days was spent conducting the study in each school system.

On the basis of findings of the study, several conclusions were drawn. In brief, the major conclusions are:

1. The critical tasks most important to the superintendents in the study were: coordinating school and community agencies, providing for the needs of exceptional children, arranging procedure for assessing and interpreting pupil growth, developing and coordinating pupil activity programs, and providing occupational and educational information services.
2. Administrators generally assume less responsibility for the guidance services than they do for the remainder of the pupil personnel services.
3. Certain characteristics of the community of the school system within a community affect the character of pupil personnel services and influence administrators' responsibilities in providing them.
4. Superintendents in small school systems did not generally assume more personal responsibility for the pupil personnel services than did superintendents in large school systems.

5. Superintendents have little direct contact with the operation of pupil personnel services or with the professional people who carry on the services in schools.
6. Principals and counselors in individual schools bear the major burden of responsibility for providing pupil personnel services.

The findings of the study provided certain implications for the pre-service and in-service training of school administrators. Briefly stated, they are:

1. In pre-service and in-service training, prospective school administrators need experience in identifying social and economic trends and in interpreting these trends in terms of pupil personnel services.
2. School administrators need the ability to coordinate the work of community agencies with that of the schools in order to secure effective pupil personnel services. Simulated administrative situations in pre-service training and in-service experience would help administrators secure this ability.
3. A pre-service course in personnel administration would help administrators obtain the ability to select for employment personnel whose training and experience coincide with the needs of their school systems.
4. A course in pupil personnel services, if included in pre-service training, would contribute to administrators' understanding of the purposes and scope of the services.

Microfilm \$3.45; Xerox \$12.15. 267 pages.

#### ELEMENTS WHICH HAVE EXTENDED THE ROLE OF THE TEACHER AND THE INFLUENCE OF THESE ELEMENTS ON TEACHERS' DUTIES IN ONE SCHOOL SYSTEM

(L. C. Card No. Mic 60-4575)

Charles Truman Roberts, Ed.D.  
The University of Texas, 1960

Supervisor: L. D. Haskey

This study traces the influences which have expanded the role of the teacher. Second, it attempts to discover and analyze the actual time investments made by teachers in one school system in noninstructional duties. As a further development, it sheds light on (1) the judged essentiality of noninstructional duties, and (2) the possibility that some duties could be performed by persons other than the classroom teacher.

#### Procedure

Educational literature of the past half century was reviewed for significant evolutions which have influenced the teacher's role. The second task is implemented by determining and analyzing teachers' investments in time in non-instructional duties in the public schools of Austin, Texas.



Checklists were completed by 75 per cent of the system's teachers which gave (1) estimates in time for the year for each of several noninstructional duties and (2) an evaluation of each duty. Administrators completed the same checklist. A checklist -- evaluating the same activities -- was completed by 10 per cent of the students and parents in the district.

#### Conclusions

1. The teacher is called upon to play a role much broader than that of furnishing instruction in the essentials of education. Significant evolutions which have influenced the teacher's evolving role are: (a) The curriculum has expanded to include more courses, community welfare activities, and special enterprises. b) Teachers have been charged with responsibility of leadership in guiding lay advisory groups. c) Professionalization activities within education have increased the concern for the individual child, his total maturation, which has given rise to additional study and changes in methods of assisting the child's development. d) Concepts of administration and supervision have changed to involve teachers in the processes through in-service techniques. e) Cultural changes -- size, jobs, and living conditions of the family and their subsequent influences on children's attitudes and behavior; the complexity of social and international changes forcing the schools to become involved; moral values and rapid media of communication intensifying the growing up process and producing student needs for additional skills -- have caused the teacher to broaden his training, experiences and planning activities. All of these developments for which the teacher shares some responsibility have expanded his role in transmitting knowledge and culture.

2. The broad role of the teacher encompasses many elements other than sheer instruction and it has been discovered in one school system that the typical teacher invests about 40 per cent of his total time to these duties.

- a. There are tremendous variations in the amount of time invested in noninstructional duties between individual teachers.
- b. Parents, students, and teachers have judged most of these broadened aspects of the school program to be essential.
- c. These noninstructional duties, because of the manner in which they are assigned in the system studied, do not interfere negatively with the satisfactory performance of instructional duties.
- d. Proposals for reducing the load of noninstructional duties do not seem logical in this school system.

- 1) If professional specialists were employed -- in addition to those already being used -- they would probably be used in the same way -- to improve learning.
- 2) The use of aides to perform these noninstructional duties would not necessarily allow teachers additional time for instruction. The work of the aide and the teacher cannot, in most instances, occur simultaneously. The actual relief appears to be minor.

3) The elimination of in-service and administrative participation by teachers would take away some proved worthwhile enlightening opportunities for teachers and no strong sentiment counter to them was exhibited in the system studied.

4) The increased school day and school year might prove advantageous but it would not reduce drastically the noninstructional duties.

5) The elimination of some of the noninstructional duties would have minor effect upon the total work load of teachers.

3. The real significance of this study is that noninstructional duties of teachers in this school system constitutes a problem but its prevalence and crucial nature can be over-magnified. There are elements in the load of teachers that can be termed "noninstructional." Yet, it turns out to be quite difficult to project a major change in the roles of modern teachers by separating organizationally or personnel-wise, such duties from classroom teaching functions.

Microfilm \$5.95; Xerox \$20.95. 465 pages.

#### KINDERGARTEN ENTRANCE AGE AS RELATED TO SUCCESS IN READING

(L. C. Card No. Mic 60-4952)

Frederick Stahuber, Ed.D.  
Rutgers University, 1960

#### Introduction

This study was prompted by the increased pressure being placed upon Boards of Education by townspeople to lower the entrance age in the local school districts. In spite of this public pressure a recent study made by the National Education Association indicated that there is a trend to raise the kindergarten entrance age. One reason given for this, by many Boards of Education, has been that the older a youngster is the better his chances will be to succeed in reading.

#### Problem

In view of the fact that chronological age has been, and seems to be, a predominant factor for admission to kindergarten, this study was designed to determine the relationship of kindergarten entrance age and achievement in reading. It was hypothesized that children who enter kindergarten at an early age are less successful in reading achievement than those children who are older at the time of entrance. Variables such as intelligence quotients, home background, emotional, social and physical maturity were excluded from this study.

#### Source and treatment of the data

The cases included in this study were children who enrolled in the kindergarten of the Township of Union's Public School System and remained for the entire period of

the study. The number of cases in the study totaled 1650 which included third grade pupils enrolled during the school years 1955-1956, 1956-1957, and 1957-1958. These 1650 pupils were divided into three kindergarten entrance age groups. Age Group 1 was composed of children who entered kindergarten with a chronological age between four years, ten months and five years, one month. Children in Age Group 2 ranged from five years, two months to five years, five months. Children in Age Group 3 ranged from five years, six months to five years, nine months.

The third grade reading mark based on a five point scale, A, B, C, D, and E, was chosen as the measure of success or failure in reading since in the Union Township School System the basic instructional program in reading was planned for completion by the end of the third grade. Also, the correlation between teacher marks and raw scores on a standard reading achievement test was found to be .81.

#### Summary of findings

In order to test the null hypothesis, the chi square was determined for the comparison of Age Group 1 and Age Group 2 for those cases that received above average reading marks and below average reading marks. The chi square for this comparison was 1.813 which was significant between the ten and twenty per cent level. The chi square for the comparison of Age Group 2 and Age Group 3 was found to be 1.935 which was significant between the ten and twenty per cent level. When the above average and below average third grade reading marks of Age Group 1 (the youngest children) were compared with the above average and below average marks received by Age Group 3 (the oldest children), the chi square was 6.668 which was significant to slightly less than the one per cent level.

#### Conclusions

Since the comparison of the reading achievement marks for Age Group 1 when compared with the reading achievement marks obtained by the students in Age Group 3 evidenced significance at slightly less than the one per cent level, the results of this analysis led us to refute the null hypothesis and therefore indicate that there is a definite significance in the findings of this study that children who enter kindergarten at an early entrance age have less chance of being successful in reading than those children who are older at the time of entrance.

There was a progressive increase in the percentage of cases that received above average marks as one proceeded from the one age group to the next older age group. Conversely, there was a progressive decrease in the percentage of cases that received below average marks when comparing entrance age groups.

Since a large number of children who were included in the youngest age group achieved a high degree of success in reading, it does appear that other variables such as emotional, social, and intellectual maturity should be thoroughly investigated to determine their effect on kindergarten entrance age policies.

Microfilm \$2.50; Xerox \$4.40. 84 pages.

#### MEETING THE NEEDS OF INSTITUTIONALIZED JUVENILE DELINQUENTS: AN ADMINISTRATIVE RESPONSIBILITY.

(L. C. Card No. Mic 60-4932)

Mary Pulley Steck, Ed.D.  
University of Maryland, 1959

Supervisors: Dr. Clarence A. Newell  
Dr. Bernard Peck

Juvenile delinquency is widespread. What to do with and for juvenile delinquents is a major social problem. It was hoped that this study would provide some insight into the needs of institutionalized delinquent boys, and assist the administrative personnel to identify and understand their roles in meeting these needs. It was also hoped that the study would provide a technique of investigation which might be used by institutions to improve the care of juvenile delinquents.

Specifically, this was a study of six delinquent boys, and a critical analysis of how their needs were met by the Reception and Orientation Programs at the Cedar Knoll School, Children's Center, Laurel, Maryland.

In order to identify the major needs of the six boys who were admitted to the Cedar Knoll School during the week of January 29, 1959, a record was made for each boy, using the case method of study. The records included recorded observations over a twelve week period, social histories, school records, psychological and physical evaluations, committee reports, and conferences with personnel and students. Using the six-area framework of analysis (physical, affectional, socialization, peer, self-developmental, and self-adjustive factors and processes) of the Institute for Child Study, the records were coded, analyzed, and summarized. The interpretation of the major needs of each of the six boys was made from these data. The data yielded information concerning the roles of the personnel and the institution in meeting the needs of these six boys.

In order to analyze how the needs of the boys were met by the Reception-Orientation Programs, an exploration of the administrative process was made. The personnel having the most direct responsibility for the six subjects were observed for a period of forty hours for each type of personnel, or a total of 200 hours. These personnel were the counselors, Social Worker, and Senior Counselor for the Reception and Orientation Cottages, and the teachers. The activities and interactions of the personnel were coded, analyzed, summarized, and interpreted according to the functional elements of administration, namely APOSDCORB. From guided interviews, job descriptions and expectational analyses were made for each type of personnel. Twelve group meetings were observed, and using the Bales Interaction Process, analyzed and interpreted in order to further examine the administrative process.

The results of the study were: (1) the physical needs of the boys were met by the institution; (2) needs in the area of affectional relationships seemed extensive, yet little information was available to the institution; (3) the Reception-Orientation Program had its greatest impact on students in the area of socialization as the counselors and teachers carried out over-all policies and procedures of the institution, but there was little coordination between cottage and school life of the students and little supervision of these



personnel; (4) the students had difficulty in peer relationships in the cottages, yet there was a lack of information concerning their peer group relationships in their communities; (5) each student was unique in his self-developmental and self-adjustive processes, but there were no coordinated programs for the individual students.

It was concluded that the Reception-Orientation Program met the physical needs of the students; additional information was needed concerning the affectional and peer relationships; there should be more coordinated effort between the various disciplines in the important area of socialization; within the broad treatment program, there should be early and constant coordinated planning for the individual student.

The techniques used in this study were found to be of value in identifying the needs of juvenile delinquents, and in analyzing a treatment program.

Microfilm \$4.05; Xerox \$14.20. 315 pages.

OPINIONS OF PRESIDENTS OF  
BOARDS OF EDUCATION IN OKLAHOMA  
CONCERNING CERTAIN PRACTICES  
PERTAINING TO TEACHER WELFARE  
AND SECURITY

(L. C. Card No. Mic 60-5197)

Maynard Roland Wilson, Ed.D.  
The University of Oklahoma, 1960

Major Professor: Claude Kelley

This study was designed for the purpose of discovering the opinions of presidents of boards of education serving the independent school districts of Oklahoma concerning certain practices pertaining to the welfare and security of the public school teacher.

The personnel practices and the opinions concerning the practices were obtained from 244 school board presidents in Oklahoma through the use of a questionnaire. The reliability of responses was established by calculating an estimate of the mean and standard deviation of the population, and the extent to which the means of the responses diverged from the population mean. Questionnaire responses were tabulated and analyzed in order to determine the extent of personnel practices and opinions of board presidents. The correlation between practices and opinions was computed by Spearman's Rank Correlation Coefficient formula. The Kendall  $\tau$  test showed the  $r_s$  to be significant at the .005 level.

Conclusions:

1. The presidents of boards of education in Oklahoma are predominantly within the age range of 40 to 49 years. Boards of Education, in general, tend to elect to the office of president a member who is middle aged and potentially able to give productive and energetic leadership.

2. In general, superintendents and school staffs in the typical Oklahoma school system may expect the president of the board of education to be a farmer.

3. The length of service on boards of education in Oklahoma indicates that the president should have ample

experience as a member of the board and therefore should know and understand the policies, duties, functions, and responsibilities of the board.

4. A majority of the presidents of boards of education have children presently attending elementary or secondary schools, or have had in the past. It would appear that this tends to be a factor in election of the president of the board of education.

5. All levels of formal education are represented by board presidents in Oklahoma and boards of education do not consistently elect individuals with the highest level of formal education as president.

6. School systems that employ 50 or more teachers tend to follow preferred teaching personnel practices more closely than do the systems that employ less than 50 teachers. It would seem, therefore, that the larger the school system, in terms of number of teachers, the more secure the teachers should feel because of more adequate teacher welfare programs.

7. Presidents of boards of education in Oklahoma in general, have opinions consistent with sound personnel practices that would attract and hold persons with qualifications for superior teaching and service.

8. The characteristics of age, occupation, children in school, level of formal education completed, and years of service on a board of education seemed to have no significant effect upon the board presidents' opinions of existing personnel practices.

9. There is still a need for board presidents who serve the independent school districts in Oklahoma to lead the boards of education in recognizing accepting, maintaining and formulating sound teaching personnel policies.

Microfilm \$3.05; Xerox \$10.60. 234 pages.

EDUCATION, ADULT

GUIDANCE NEEDS OF THE ADULT  
EXTENSION STUDENT OF THE  
UNIVERSITY OF OKLAHOMA

(L. C. Card No. Mic 60-5190)

Howell Walton McGee, Ed.D.  
The University of Oklahoma, 1960

Major Professor: Dr. Funston F. Gaither

This study was designed to locate the areas of expressed problems of adult part-time students in extension credit classes. It was hypothesized that factors of sex, marital status, age, and occupation would be an influence on the type and frequency of problems.

The stated problems of the adult student were obtained from 276 part-time students enrolled in extension centers of the University of Oklahoma. The data were obtained from replies to a questionnaire which was developed to locate problem areas. The results were classified according to eight basic problem areas: Employment and Economic Security, Health, Current Educational Problems, Social Personality, Self-Improvement, Home and Family, Personality Introspect, and Moral and Spiritual Values.

The response were analyzed to determine any effect of sex, marital status, age, and occupation to the total number of individual problems and to the problem areas.

The findings showed that factors of sex and marital status did not support the hypothesis. Only in the area of Personality Introspect was there any significant difference between the sexes. Marital status showed differences in Personality Introspect and Home and Family Life. The factors of age and occupation showed many group differences.

The area of Current Educational Problems had the largest number of problems with an incidence of thirty-eight per cent. Social Personality was the second largest area with thirty-one per cent. The students had only seven per cent of problems in the areas of Health and Moral and Spiritual Values. The range for the other areas was from twelve to twenty per cent.

#### Conclusions:

From the evidence available, there is a demonstrated need for guidance services to the part-time adult student in extension credit classes. It is difficult to know in which areas these services should be offered since there has been no critical ratio established. However, only the areas of Health and Moral and Spiritual Values had less than a ten per cent incidence of problems.

It can be expected that factors of marital status and sex will have little bearing on the problems to be encountered in counseling with adult students. These cannot be totally ignored but will tend to be more of an individual matter.

The age and occupation of a person will present several factors to be considered in counseling. This study demonstrated that the younger students will have more and varied problems. There was some evidence that in areas such as Health, Personality Introspect, and Moral and Spiritual Values, the counselor may find more problems in those students who are over forty-five years of age. It can be anticipated that the less education a person has, as it related to the requirements for employment, the more problems he may present. This is particularly true in the areas of Employment and Economic Security and Current Educational Problems.

Microfilm \$2.50; Xerox \$6.60. 137 pages.

#### EDUCATION, HISTORY

##### THE AMERICAN HISTORICAL ASSOCIATION AND THE SCHOOLS, 1884-1956.

(L. C. Card No. Mic 60-4639)

Howard Rai Boozer, Ph.D.  
Washington University, 1960

Chairman: Adolph Unruh

The purpose of this study was to trace the activities relating to American elementary and secondary education of the American Historical Association from its founding

in 1884 through 1956. This chronological account should be of use to the Association, the National Council for the Social Studies, and others who are interested in the development of better understanding and better communications among educators in arts and sciences and in professional education.

The American Historical Association was organized in 1884. Between 1896 (when its first committee on history in schools was appointed) and 1956 the Association had eleven "permanent" committees concerned with the preparation of teachers and the teaching of history and the social studies in the schools. Since 1911 it has also been involved in varying degrees with the editing or financing of a journal for teachers of history and the social studies. The Association was particularly influential in matters affecting the teaching and content of school history up through the first decade of this century. This influence began to decline before and during World War I, and with the maturation of the other social sciences, the general broadening of secondary education, the development of curriculum specialists and of professional education, and the creation in 1921 of the National Council for the Social Studies, its influence decreased further.

After several years of reappraisal and planning, the Association in 1928 appointed the Commission on the Social Studies, made up of representatives of history, other social sciences, and professional education. This Commission, although it was not without influence in American education, differed from most of the earlier Association committees in that it did not present specific curriculum recommendations. Since 1920, except for the 1944 report of the Committee on American History in Schools and Colleges, committees of the Association have not set forth the details of particular courses of study, but have attempted to provide assistance to teachers in other ways. Illustrative of this change of emphasis is the Committee on Teaching, appointed in 1953, which has as its major function the operation of a Service Center for Teachers of History, established in 1956. The Service Center has published for teachers a number of pamphlets concerning recent research and interpretations in the field of history. It has also developed a roster of historians who have indicated a willingness to be of assistance, when so requested by teachers.

On balance, the American Historical Association has demonstrated a fairly continuous interest in educational matters relating to the lower schools. The learned societies draw their members largely from among college and university specialists. The main focus of their interests, by definition, is in their specialties. Hence, informed interest and activities relating to the schools have in many learned societies been the exception rather than the rule. The American Historical Association, it may be contended, is one of the exceptions. Similar studies of other learned societies would provide useful additional insight into the nature and effectiveness of the participation of scholars and scientists in the preparation of teachers and in the teaching of particular subjects in the schools.

Microfilm \$5.80; Xerox \$20.50. 455 pages.



**A STUDY OF THE LEGAL ASPECTS  
OF FISCAL INDEPENDENCE OF  
SCHOOL COMMITTEES IN MASSACHUSETTS**

(L. C. Card No. Mic 60-5234)

Wayne Meredith Holmes, Ph.D.  
The University of Connecticut, 1960

The purpose of the study was to analyze the legal aspects of fiscal independence of school committees in Massachusetts. A study was made of the statutes pertaining to fiscal independence and an analysis of court interpretations was made.

The author developed the study through the following steps:

1. A review of the present status of fiscal independence of school committees in Massachusetts.
2. An analysis of Massachusetts colonial statutes relative to fiscal policies for public education.
3. A study of the present statutory basis for fiscal independence in Massachusetts.
4. A statement of opinions of several educators relative to fiscal independence for boards of education and school committees.
5. A comparison of the relative merits of fiscal independence and fiscal dependence.
6. A consideration of cases tried before the Supreme Judicial Court of Massachusetts testing the validity of the statutory basis for fiscal independence in Massachusetts.
7. A discussion and analysis of recent bills brought before the General Court of Massachusetts designed to weaken or abolish fiscal independence.

From the evidence gathered the author developed three assumptions:

1. Opponents of fiscal independence in Massachusetts are generally not motivated by a desire to improve public education, while school committees are generally composed of persons who are interested in public education.
2. School committees are responsible only for school affairs. In this respect they are unlike city councilmen, mayors, or selectmen who must be actively concerned with the workings of an entire city or town government. With this single responsibility school committeemen come to know schools in a way that municipal government officials cannot.
3. There is nothing to prove that school committees are more careless with the public purse than are any other government officials.

The author stated three reasons for concluding that the present statute which authorizes fiscal independence for school committees in Massachusetts (sec. 34, ch. 71 of the General Laws) is unsatisfactory. These reasons follow.

1. It is a statute which has been violated with impunity because its violation is not brought before the superior court by ten taxable inhabitants, the mayor, or the attorney general.
2. Once a judgment has been given against a municipality under this statute it does not preclude the commission of further violations in subsequent years. If a municipality chooses to violate the statute each year it may do so, and many municipalities do just this.

3. The statute does not state that the school committee shall be the agency to determine the amounts of money sufficient for the support of public schools, or that the courts shall be guided in determining the amounts of deficiencies by the school committees' recommendations. These two principles have been established purely by judicial interpretation.

A study of the statutes, court cases, and proposed legislation to modify the law provides evidence that the law should be altered, making it impossible for a municipality to gain state approval of its annual tax rate without supplying proof that the local school committee's budget has been accepted and included in the municipality's budget exactly as it was received from the school committee.

Microfilm \$2.50; Xerox \$6.20. 126 pages.

**THE PHILOSOPHICAL AND PSYCHOLOGICAL  
ANTECEDENTS OF THE CORE CURRICULUM IN  
EDUCATIONAL THEORY: 1800-1918.**

(L. C. Card No. Mic 60-4869)

Elizabeth Cole Stack, Ph.D.  
The University of North Carolina, 1960

Supervisor: J. Minor Gwynn

The purpose of this study was to trace the factors that contributed to the concept of the core curriculum through an analysis of the European and American philosophical thought and psychological theories of the nineteenth century and early twentieth century. Though the core curriculum does exist in American education today and seems to be an emerging pattern of general education, some questions about its impetus were unanswered. These questions involved the philosophies which gave the core concept its foundations; the philosophers that were most influential; the psychological theories that contributed to the concept of core development; perhaps some psychological theories were more important than others in their influence; and the American writers and committees of national educational organizations that influenced the development of the core curriculum.

The study analyzed and classified the writings and reports which were involved in an attempt to discern similarities and differences. A limitation of time, 1800-1918, was necessary in order to analyze critically the philosophical and psychological development within this given period that contributed to the core curriculum concept.

The study revealed that the core curriculum entered the main stream of American educational thought prior to 1918. The evidence clearly indicated that the philosophic and psychological antecedents of the core curriculum existed and were fully developed during the period, 1800-1918. Certain individuals, reports, or experiments were found to be most significant in their contribution to the theory and practice of concepts of the core curriculum.

Three handicaps appeared in the development of the core curriculum prior to 1918 and still exist today: (1) the scope and sequence of the curriculum that deals with inter-related learning; (2) teacher preparation for core programs; and (3) the relationships between general education and the core curriculum.

This study was not designed as a definitive investigation of the philosophical and psychological antecedents of the core curriculum from its earliest inception to 1960. Other studies should be made in order to obtain a complete analysis of the core curriculum in American education:

1. A study should be made of philosophic foundations of the core curriculum in educational theory prior to 1800.
2. A study should be made of the philosophical and psychological foundations of the core curriculum from 1918, showing how it developed in educational theory through World Wars I and II, the depression years and the inflationary aftermath of 1945.
3. A study should be made showing how the core curriculum came to be a philosophic concept of higher education.
4. A study should be made showing the various relationships between general education and the core curriculum.

Microfilm \$4.20; Xerox \$14.85. 327 pages.

#### EDUCATION, PHYSICAL

##### THE EFFECTS OF PARTICIPATION IN SELECTED PROGRAMS OF WEIGHT-TRAINING ON THE PHYSICAL-FITNESS OF ATHLETES

(L. C. Card No. Mic 60-5643)

Robert Lee Campbell, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor Arthur J. Wendler

The purpose of this study was to determine the effects of weight-training, when used to supplement normal training-procedures, upon the physical fitness of male students enrolled in physical-education skills classes, and upon the physical-fitness of football, basketball, and track-and-field athletes.

The subjects (male students at Wartburg College, Waverly, Iowa) used in this study were thirty-four physical-education skills students with a high level of fitness, thirty-four physical-education skills students with a low level of physical-fitness, thirty-six football squad members, ten freshman basketball squad members, and sixteen track-and-field squad members. Each of these groups was divided into two matched groups: one group engaged in weight-training during the first half of the season but did not engage in weight-training during the second half of the season, and the other group did not engage in weight-training during the first half of the season but did engage in weight-training during the second half of the season.

Seven tests--Right Grip, Jump and Reach, Squat-Thrusts, Pullups, Situps, Three-Hundred-Yard Shuttle Run, and Fifty-Yard Dash--were administered to all the groups at the beginning of the season, at midseason, and at the end of the season.

An analysis of the data by a Type II Analysis of Variance yielded the following findings:

- (1) The difference in the gains for the weight-training groups and the nonweight-training groups

during the first half of the season are comparable to the difference in the gains for the weight-training groups and the nonweight-training groups during the second half of the season.

- (2) The gains of the weight-training and nonweight-training groups during the first half of the season are greater than the gains of the weight-training and nonweight-training groups during the second half of the season.

- (3) The groups that did not participate in weight-training the second half of the season showed more mean losses than the groups that did not participate in weight-training the first half of the season.

- (4) The mean gains of the weight-training groups the first half of the season and those of the weight-training groups the second half of the season are greater than the mean gains of the nonweight-training groups the first half of the season and those of the nonweight-training groups the second half of the season.

The results obtained in this study would seem to warrant the following conclusions:

- (1) The mean gains that accompany participation in weight-training in one half of a season are comparable to the mean gains that accompany participation in a program of weight-training in the other half of the season.

- (2) The first half of a training season appears to be more effective for physical conditioning than does the second half of a training season.

- (3) In view of the losses in physical condition suffered by the nonweight-training groups during the second half of the season, it would appear that weight-training should be continued throughout the season.

- (4) A program of normal conditioning-procedures supplemented by weight-training produces a greater increase in physical-fitness than does a normal conditioning-program alone.

Microfilm \$2.50; Xerox \$7.40. 160 pages.

##### THE EFFECT OF SYSTEMATIC WEIGHT TRAINING ON FLEXIBILITY, SPEED, AND STRENGTH IN ADOLESCENT BOYS.

(L. C. Card No. Mic 60-4710)

Raymond Arthur Ciszek, Ed.D.  
Boston University School of Education, 1960

The purpose of this study was to determine the effect of a systematic heavy resistance exercise program on the range of selected joint movements, speed of arm and leg movements, and hand and leg strength in high school boys. A weight training program was designed to exercise the major muscle groups of the body with emphasis on the development of arm and leg strength.

The experiment was conducted with the assistance of 100 high school sophomore boys regularly enrolled in the required physical education program at two schools. Fifty



boys from Bellingham High School, Bellingham, Washington, comprised the weight training group. A similar number of boys from Mt. Baker High School, Deming, Washington, was selected as the control group. The groups were equated on the basis of age, handgrip strength, and two measurements on the Wetzel Grid, isodevelopmental level and developmental channels.

In recording the range of joint movement, four of the measurements were recorded with the use of a flexometer. The instrument contained a weighted pendulum centered on a 360° protractor strapped to the part of the body being measured. Shoulder extension was determined with the use of sliding calipers.

Speed measurements were recorded with apparatus specifically designed for the purpose. The rate of arm movement was based on turning a six-inch-radius crank in the sagittal plane 18 revolutions. The speed of leg movements was determined by pedaling an unloaded bicycle mechanism 20 revolutions. Time for these measurements was recorded to the one hundredth of a second.

Measurements of hand and leg strength were determined with standard strength-testing equipment: Smedley Hand Dynamometer and an A. G. Tieman and Company back and leg dynamometer.

Five anthropometric measures were included in the study: height, weight, and circumference of the upper arm and lower leg. Age was also recorded.

Training sessions for the equated groups meeting three times a week for 12 weeks were conducted during the scheduled physical education period. The experimental group engaged in seven progressive resistance exercises. The control group participated in the regular activities taught in the physical education program. Weight training was not included in these activities.

The 5 per cent level of significance was selected by the investigator as the level with which to statistically reject the null hypothesis. As there were 50 subjects in each group, 49 degrees of freedom ( $N-1$ ) were used in ascertaining the significance of difference; a critical ratio ( $t$ ) of 2.01 was necessary to be significant at the 5 per cent level of confidence.

Final testing, using the same procedures as the original test, was conducted following the experimental period. The control group recorded increases in each of the flexibility measurements; these changes were not significant. The experimental group increased in three measures of flexibility and decreased in two of these measures. The only significant mean change for this group was a decrease in the range of knee movement. An analysis of the final test data in the measurements of flexibility for both groups revealed a significant change only in range of movement of the hip joint for the experimental group over the control group. In the measures of arm and leg speed both groups increased their rate of movement over their initial scores. A significant difference was recorded for the weight-trainees over the controls in leg speed. With the exception of a slight loss in hand-grip strength recorded for the controls, both groups showed an increase over their initial scores on the strength variables. In both hand-grip and leg strength the experimental group recorded significant gains over the control group. Increases in anthropometric measurements, recorded for both the weight-trainees and non-weight-trainees, showed a significant increase in upper-arm girth for the weight-trainees.

The findings of the study were as follows:

1. No over-all changes in the range of joint movement were recorded for either group; only in the range of hip movement was there a significant increase for the experimental group over the controls.
2. Twelve weeks of systematic weight training produced a significant increase in the rate of leg movements.
3. Participation in the weight training exercises produced a significant mean gain in hand-grip strength for the experimental group.
4. The weight training program resulted in a significant increase in leg strength for the weight-trainees.
5. A significant mean increase in upper-arm girth was recorded for the experimental group.
6. A 12-week systematic weight training program performed in a manner described in this study, was of sufficient duration to induce change in the individuals taking part.

Microfilm \$2.50; Xerox \$6.40. 135 pages.

#### MEASUREMENT OF ACHIEVEMENT IN FUNDAMENTAL SKILLS: ELEMENTARY-SCHOOL CHILDREN.

(L. C. Card No. Mic 60-5667)

Robert Darwin Johnson, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor Arthur J. Wendler

The purpose of this study was twofold: (1) to develop methods of measuring elementary-school children's achievement (Grades 1 to 6) in selected fundamental skills; and (2) to establish performance norms for each of the selected skills.

The subjects were elementary-school boys and girls from seven cities of southern Minnesota.

The developmental testing program included about fifty boys and fifty girls (Grades 1 to 6) from one city. The data that were collected include the ages, the heights, and the weights of the subjects; and scores on and rankings for ability in (1) a kicking-test, (2) a pass-and-catch test, (3) a jump-and-reach test, (4) an agility-run test, and (5) a batting-test.

The data that were used to establish performance norms for the five tests were collected on 2,459 boys and 2,195 girls in Grades 1 to 6.

The  $r$ 's of reliability that were obtained for the five tests are, for each sex and for each grade, statistically significant ( $P$ 's = .01). The  $r$ 's of validity of the tests (criterion rankings by teachers) are, for most of the tests, statistically significant ( $P$ 's = .01).

For each of the five tests and for each sex an analysis of the difference between the mean scores for one grade and the mean scores for the succeeding grade shows, except between grades five and six, an upward trend from grade to grade.

The  $r$ 's that were obtained between performance as measured by the five tests and age, height, and weight are,

according to grade and to sex, low ( $P$ 's = .05). The  $R$ 's that were obtained between the criterion and height are, for each test, negligibly higher than the  $r$ 's that were obtained between the criterion and age.

Performance norms were computed on the basis of the obtained results. Percentile ranks were computed for each test according to sex and to grade.

The findings of this study would appear to warrant the conclusion that reliable and valid tests of performance have been developed for selected motor areas for boys and girls in Grade 1 to 6.

The age, the height, and the weight of boys and girls in Grades 1 to 6 appear to have low relationships with performance on these tests of fundamental skills.

Mean scores show an upward trend ( $P$ 's = .05) from Grades 1 to 5. The tests do not, for the five fundamental skills, differentiate between the levels of ability of the fifth- and sixth-grade subjects.

The mean scores of the boys in any one of the six grades are, with one exception, higher than the mean scores of the girls for the same test and grade.

Microfilm \$2.50; Xerox \$4.60. 88 pages.

#### AN ELECTROMYOGRAPHIC STUDY OF THE GLUTEUS MAXIMUS, THE VASTUS LATERALIS, AND THE TENSOR FASCIAE LATAE.

(L. C. Card No. Mic 60-5682)

Homer Hamlin Merrifield, Ph.D.  
State University of Iowa, 1960

Cochairmen: Assistant Professor Gene M. Asprey  
Associate Professor Max D. Wheatley

The purpose of this study was to investigate by means of electromyography the functions of the gluteus maximus, the vastus lateralis, and the tensor fasciae latae.

Eight graduate students that were enrolled in the Department of Physical Education for Men at the State University of Iowa served as subjects. By means of the Grass Model III-D Electroencephalograph, electromyograms were collected for movements that involved the leg, the thigh, and the trunk. The individual movements of thigh extension, thigh extension-inversion, thigh extension-eversion, thigh extension-abduction, thigh extension-adduction, thigh flexion, thigh flexion-inversion, thigh flexion-eversion, thigh flexion-abduction, and thigh flexion-adduction were performed against no resistance and then repeated against thirty pounds of resistance. Movements of leg extension in the sitting, the supine, and the prone positions were performed against no resistance and were repeated against forty pounds of resistance. The trunk movements of flexion, extension, lateral flexion, and hyper extension were performed against no resistance. Excluding leg flexion and extension, all individual movements were performed with the leg flexed and then repeated with the leg extended. Combined movements of walking, walking upstairs, walking downstairs, and the vertical jump were performed in the normal position and then repeated with the trunk flexed at ninety degrees.

A gravity goniometer was used to measure the range of motion as the subjects performed thirty individual move-

ments. For the eight subjects, little relationship was found between the number of degrees of flexibility and the size of the pen deflections shown on the electromyograms.

The findings that compare favorably with the results of other electromyographic studies include the following:

1. The gluteus maximus registered action potentials during extension and abduction of the thigh, extension of the trunk, and stepping upstairs.
2. The vastus lateralis registered action potentials during all the movements performed with the leg extended and during leg extension.
3. The tensor fasciae latae registered action potentials during flexion, abduction, flexion-adduction, flexion-abduction, and extension-abduction of the thigh, and extension of the leg.

The following observations have not been previously reported by investigators:

1. The gluteus maximus registered action potentials during extension-inversion, extension-eversion, extension-abduction, and extension-adduction of the thigh; during the latter part of thigh flexion-abduction against resistance; during the latter part of flexion and extension of the leg against resistance; and in lateral flexion, extension, and hyper extension of the trunk.
2. The vastus lateralis registered action potentials during lateral flexion and flexion of the trunk.
3. The tensor fasciae latae registered action potentials during flexion-inversion, flexion-eversion, and extension-inversion of the thigh; lateral flexion and flexion of the trunk; and during the latter part of leg flexion.

Action potentials were, in the normal position and with the trunk flexed, recorded from the three muscles during the following combined movements: walking, walking upstairs, walking downstairs, and the vertical jump.

For the individual movements, action potentials of greater magnitude were registered when the movements were performed against resistance than when the movements were performed against no resistance.

Microfilm \$2.50; Xerox \$7.00. 150 pages.



**A SITUATION-RESPONSE PHYSICAL  
EDUCATION ATTITUDE SCALE  
FOR SOPHOMORE HIGH SCHOOL BOYS**

(L. C. Card No. Mic 60-6592)

Hassan Sayed Moawad, P.E.D.  
Indiana University, 1960

Chairman: Dr. Karl W. Bookwalter

Problem

The problem was to develop a valid and reliable instrument which could be used to measure the attitudes of the sophomore high school boys toward physical education.

Procedure

The curricular validity of the scale was established by an analysis of physical education text books and by judgment of competent persons in the field.

The situation-response technique of item construction was adopted. A multiple-choice, five-alternative item was used to create the scale. A situation was described which was followed by five possible ways of reacting in that situation. The student was asked to select the alternative which was closest to what his actual response would have been.

About 200 items were originally constructed, which were reduced to 95 items after being tested for:

1. Criteria of a good attitude item, observing Wang's criteria.
2. Word difficulty, using the Thorndike and Lorge word list.
3. Ambiguity, irrelevance, and sentence construction, checked by the doctoral committee.

The 95 items were organized into two equal preliminary forms. These forms were sent to eight selected judges who weighed the alternatives of each item.

Each preliminary form was administered to 164 sophomore boys in Indiana. An analysis of the results showed the following facts:

1. The final scale should include approximately 70 items.
2. Four items were rejected because one or more of their options were not functioning in three per cent of the cases.
3. Eight more items were rejected because they were not discriminating between the upper and lower 27 per cent of the students at the five per cent level of confidence.

From the 83 valid items, 13 more items were rejected because they were overlapping. The remaining 70 items constituted the Final Form.

The Final Form was administered to 352 sophomore boys in 15 randomly selected high schools in Indiana.

The split-halves method was used to establish the reliability of the scale. The reliability coefficient was found to be .915 when the Spearman-Brown prophecy formula was used. Norms were established in terms of percentile ranks and T-scores.

Conclusions

1. The Final Form is a valid and reliable measure of the attitudes towards physical education of the sophomore high school boys in the state of Indiana.
2. The scale is objective in terms of scoring.
3. The scale is economical to administer, in terms of time and cost.
4. The sophomore boys of the high schools belonging to Category II (enrollment from 101 to 500) have more favorable attitudes toward physical education than the sophomore boys belonging to either Category I (00-100) or to Category III (501 and above).
5. The attitudes of the sophomore boys is slightly superior for the neuro-muscular Development area as compared with the other areas.

Recommendations

1. By use of norms established, school, class, and individual comparisons may be made.
2. Norms also may assist teachers in appraising the attitudes of their students.
3. The scale may enable the teacher to understand the attitudinal basis from which his students learn.
4. The quality of teaching, in terms of planting desirable attitudes in the students, may be evaluated by administering the scale at the beginning and end of the school year.
5. Attitude research should be encouraged in the physical education field.
6. Different attitude scales for all school levels, and for both sexes, should be developed, with norms for each level.
7. Other approaches, too, than the situation-response technique should be encouraged.

Microfilm \$2.60; Xerox \$9.00. 198 pages.

**THE DEVELOPMENT OF AN INSTRUMENT  
FOR EVALUATION OF AN IN-SERVICE  
GRADUATE ASSISTANTSHIP PROGRAM IN  
PHYSICAL EDUCATION AND RECREATION**

(L. C. Card No. Mic 60-4711)

Ben A. Plotnicki, Ed.D.  
Boston University School of Education, 1960

Statement of the Problem

This study was undertaken for the purpose of constructing an instrument to be used in evaluation of an in-service graduate assistantship program at the University of Tennessee. This program provides for assistantships which are sponsored by local schools and recreation agencies and are awarded in return for part-time services by graduate students. During their year of graduate study these students receive practical experience in physical

education and recreation under the guidance and supervision of experienced school supervisors and teachers, qualified recreation leaders and university personnel.

### Procedures

Data pertinent to the formulation of the instrument were collected by the following methods: (1) introspection as a means of thoroughly and critically reviewing the purposes of the entire program, the administration, organization and operation of it; (2) personal interviews with administrators and supervisors of the local schools and agencies associated with the graduate assistantship program; (3) a comprehensive review of pertinent literature; and (4) a questionnaire formulated and sent to 134 former graduate assistants requesting information and opinions from them with respect to the program.

In accordance with an interpretation and understanding of the information gathered, a pilot instrument was developed which encompassed the following major divisions of the assistantship program: organization and administration; recruitment; selection; orientation; supervision; on-the-job evaluation; and job placement and follow up.

The pilot instrument was submitted to 30 jurors for suggestions and criticisms. Jury members selected to evaluate the pilot instrument were chosen from three different groups so that criticisms would tend to reflect different points of view. The groups included: (1) those working with the assistantship program each day; (2) former graduate assistants currently working in teacher training colleges; (3) college teaching personnel familiar with the program but not directly connected with it.

Having selected 75 per cent or more agreement by the jurors as the level of acceptance, the writer recorded the suggestions of all jurors and made the justifiable changes in the instrument. Inasmuch as the suggested criticisms dealt mainly with rewording of various items for clarity, the validity of the instrument was established by the nearly complete agreement and approval of the jurors.

The instrument in its final form was applied by a selected committee in evaluation of the Tennessee graduate assistantship program.

The results of the evaluation were tabulated and analyzed and conclusions were drawn.

### Conclusions

1. The instrument as revised and approved by the jurors contained those standards which were found to be important for an effective in-service graduate assistantship program.
2. The instrument developed in this study could serve as a guide in initiating similar in-service assistantship programs at other colleges and universities.
3. The instrument developed in this study provided a satisfactory means of examining and evaluating the Tennessee in-service graduate assistantship program.
4. As measured by the instrument, the Tennessee graduate assistantship program received a high rating, with a total score of 323 out of a possible score of 340.

5. The Tennessee program was found to be the most satisfactory in the area of organization and administration.
6. The Tennessee program was found to be the weakest in the areas of supervision and orientation.
7. To strengthen the graduate assistantship program, the following adjustments must be made to minimize the weaknesses as revealed by the application of the instrument:
  - a. Improved orientation practices
  - b. More adequate supervision by the physical education and recreation staff
  - c. More frequent group conferences for assistants and their university supervisors
  - d. Closer working relationship between university physical education and recreation staff and the school (and agency) administrators
  - e. Regular follow-up procedure used to maintain better contacts with former assistants
  - f. More consideration given to job placement.

Microfilm \$2.50; Xerox \$8.20. 177 pages.

### ELEMENTARY SCHOOL HEALTH AND PHYSICAL EDUCATION PROGRAM STANDARDS AND RELATED VARIABLES COMPARED WITH PUPIL ACHIEVEMENT ON FIVE ITEMS OF THE AAHPER YOUTH FITNESS TEST

(L. C. Card No. Mic 60-6593)

Otto Hugh Spilker, P.E.D.  
Indiana University, 1960

Chairman: Dr. Karl W. Bookwalter

**PROBLEM** The purpose of this study was to determine the relationship existing between the performance of selected Indiana fifth and sixth grade boys on composite scores of selected items of the AAHPER YOUTH FITNESS TEST and the rating of their schools on the total score of the Health and Physical Education Score Card No. I. It was also proposed to ascertain whether school corporation size, school size, and state accreditation factors affected such relationships.

**PROCEDURES** A pilot study was conducted to permit the author to become proficient in the correct use of the Health and Physical Education Score Card No. I and in the correct administration of the selected test items. The selected items of the AAHPER YOUTH FITNESS TEST were: (1) pull-ups; (2) sit-ups; (3) standing broad jump; (4) shuttle run; and (5) 50-yard run. Quality of a physical education program was determined through use of the Health and Physical Education Score Card No. I. The corporation size, school size, and state accreditation of each school was obtained from the Office of the State Superintendent of Instruction, State House, Indianapolis, Indiana.



The 366 public elementary schools located essentially within a 50 mile radius of Bloomington, Indiana, were alphabetically listed and a corporation size and school size grid made in order to have a random stratified sample. The table of random numbers was used to select 42 schools, which were scored and ranked, high on top. A score card and state accreditation grid was made and the table of random numbers used to select six schools from the upper, middle, and lower thirds of the ranked list. The five test items were administered to 689 fifth and sixth grade boys.

The four separate hypotheses under test were that the unweighted mean of the composite scores is the same for:

1. Low, middle, and high scoring schools, as determined by the Health and Physical Education Score Card No. I.
2. School corporation sizes 68 to 497, 505 to 2039, and 2143 to 9464.
3. School sizes 33 to 172, 185 to 315, and 332 to 832.
4. Schools with state accreditations designated as Certified, Continuous Commission, and First-Class Commission.

The four analyses were performed singularly by regrouping the schools according to the hypothesis under test.

The five per cent level of confidence was selected as the level for determining significance for all tests throughout the investigation. The same "Basic Plan of Analysis" was followed in each analysis. The "Groups-Within-Treatments Design" was used to analyze the data and when appropriate Bartlett's Chi Square and the "t" test, for samples taken two at a time, were performed. This procedure permitted, within each analysis, a test of significance of the difference between the three samples and, when necessary, the location of the superior sample or samples.

#### CONCLUSIONS

1. It would not be unreasonable to expect a high quality elementary school physical education program to enhance the development of physical fitness of fifth and sixth grade boys.

2. School corporation size does not appear to make any difference when compared with the performance of fifth and sixth grade boys on selected items of the AAHPER YOUTH FITNESS TEST.

3. School size does not appear to make any difference when compared with the performance of fifth and sixth grade boys on selected items of the AAHPER YOUTH FITNESS TEST.

4. It would not be unreasonable to expect a "First Class Commission" elementary school to enhance the development of physical fitness of fifth and sixth grade boys.

Microfilm \$2.50; Xerox \$5.20. 101 pages.

#### A PERFORMANCE ANALYSIS OF THE PROPULSIVE FORCE OF THE FLUTTER KICK

(L. C. Card No. Mic 60-5701)

William Robinson Thrall, Ph.D.  
State University of Iowa, 1960

Chairman: Professor Louis E. Alley

The purpose of this study was to investigate by means of a performance analysis the effect that (1) the size and the shape of the feet and (2) the frequency of the kick have on the propulsive force of the flutter kick used in swimming the crawl stroke.

The subjects were three members of the Kansas State University intercollegiate swimming team. The free velocities of each of the subjects were determined when the subject used (1) the normal kick, (2) the feathered kick, (3) the arm stroke alone, and (4) combinations of kicks and arm strokes. Also, the free velocities of each of the subjects were determined for each of the four items except (3) the arm stroke alone when the subject was wearing wide fins and when the subject was wearing narrow fins.

An apparatus was constructed to tow a subject at controlled velocities and was used to measure the drag and the towing-force exerted by the subject. (Drag is the force required to tow a subject in the drag position through the water at any given velocity. Towing-force is the force required to tow a subject through the water at velocities greater than the subject's free velocity for the kick alone. During this measurement the subject kicks while being towed.) Towing-force data were collected over a range of velocities when the subject was using (1) the normal kick, (2) the feathered kick and (3) combinations of kicks and fins. The drag and the difference between the drag and the towing-force (effective propulsive force) were analyzed graphically.

A greater free velocity and a greater effective propulsive force were obtained when the subjects used the normal kick than when they used the feathered kick. The adding of fins (to increase the effective size of the feet) produced a mean increase in the free velocity and in the effective propulsive force of the kick. For two of the three subjects, there was an advantage in using the normal kick when the subject wore narrow fins rather than in using the normal kick when the subject wore wide fins. As the towing velocity was increased above 5 ft/sec, the subjects experienced increasing difficulty in keeping the kick underwater.

The findings in this study would appear to warrant the conclusion that at a stroke frequency of one arm-stroke cycle a second the action of the legs in the sprint crawl stroke should involve six beats, and not two beats, of a kick for each arm-stroke cycle. The kick should originate at the hip joint, and the action should be transmitted through the thigh to the knee joint; and in a whiplike motion the leg should press backward with special emphasis upon the backward and downward lash of the instep. The ankle joint should be flexible to permit a large range of extension. The width of the flutter-kick stride should not be more than twelve inches, and the kick should be close to the surface so that the kick may raise the legs in the water to reduce the resistance that must be overcome with the arm stroke. For an effective kick in swimming, the foot should be long, thin, flexible, and large in surface area with which to exert force against the water.

Microfilm \$2.50; Xerox \$4.20. 80 pages.

THE RELATIVE EFFECT OF MENTAL  
PRACTICE AND PHYSICAL PRACTICE IN  
LEARNING THE TENNIS FOREHAND  
AND BACKHAND DRIVES

(L. C. Card No. Mic 60-5705)

Margaret Eileen Wilson, Ph.D.  
State University of Iowa, 1960

Chairman: Professor M. Gladys Scott

The primary purpose of this study was to investigate the relative effects of three combinations of mental and physical practice in learning the forehand and backhand drives in tennis. Subproblems were investigated as follows:

1. Comparison of the performance curves for the three groups over the training period;  
and
2. Determination of the relationship between three selected tests of aptitude and the change in proficiency which occurred in the mental and physical practice groups.

Subjects for the study were 75 women students at the State University of Iowa who had previously taken at least one course in tennis. These subjects were given skill ratings by three competent tennis instructors and were classified as low intermediate, high intermediate, or advanced players.

Following the administration of the Broer-Miller Tennis Test for pre-test scores, subjects were placed in three groups. Each group repeated the Broer-Miller Test every other day through twelve days. The control group did not participate on alternate days; the physical practice group made 28 hits against the gymnasium wall; and the mental practice group mentally repeated the test in a classroom. Five coaching cues were emphasized throughout the practice sessions. Subjects were asked not to think of tennis at any time except during the sessions. The physical and mental practice groups also took the tests for Space Relations, Mechanical Reasoning, and Abstract Reasoning of the Differential Aptitude Series.

A "t" test of significance was used to determine whether or not the mean gain for the total group of experimental subjects was greater than zero. The null hypothesis was rejected at the one percent level of confidence.

Analysis of variance was used to test the hypothesis that the mean gains for the three groups were equal. Results indicated that the gain made by any one of the groups could not be regarded as evidencing greater learning than that made by either of the other groups.

Analysis of covariance was also used to test the hypothesis that final performance of the three groups was equal. The null hypothesis was retained at the five percent level of confidence. Therefore, the observed differences in the adjusted means could not be regarded as proof of the

greater effectiveness of any one of the three types of practice over the others.

Learning curves were plotted for low and high skill levels for each group. Analysis of variance was used to test the parallelism of the two curves and indicated that in each case the highly skilled subjects had scores significantly higher than those of the lesser skilled subjects but that day by day differences between the levels were not significant.

Rank-Difference correlations between the aptitude test scores and the differences between pre- and post-test scores for the mental and physical practice groups ranged from .461 to -.282 which indicated little relationship between the written tests and ability to perform the drives.

The following conclusions seem justified:

1. The total group of experimental subjects shows significant gain in proficiency.
2. There is no indication that the form of practice produces significant differences in the comparative performances of the three groups.
3. The subjects assessed by the skill ratings as "high" maintain their clear-cut superiority throughout the practice. There is no evidence of marked change in the difference between the more highly skilled and the lesser skilled subjects throughout the training for all three groups.
4. The Space Relations, Mechanical Reasoning, and Abstract Reasoning Aptitude Tests do not measure those factors which contribute to increased proficiency under either training condition.

Microfilm \$2.50; Xerox \$5.20. 104 pages.

EDUCATION, PSYCHOLOGY

DRIVE QUALITIES EMERGING FROM  
CONSISTENT EXPERIENCES

(L. C. Card No. Mic 60-4942)

Edith Eunice Adler, Ed.D.  
Rutgers University, 1960

Statement of the Problem

Evidence derived from recent experimental work on both the stimulus change effect and exploratory or manipulatory behavior has cast some doubt on the generally held assumption that, in order for behavior change to occur, organic drives must be involved either directly or



indirectly. The present investigation is an attempt to explore further the implications of this apparent negation of classical drive-reduction theory. It was designed to ascertain whether a sensory stimulus without any known drive-reducing properties, if experienced consistently, could function as an effective reinforcer in a learning situation. It makes use of the supposition that in simple learning situations, two distinct processes may be discerned; one, the acquisition of the response itself (act); and two, the acquisition of expectancies which sustain that act.

The hypotheses to be tested are:

1. The occurrence of a stimulus event which has been consistently experienced in a specific context can have a reinforcing effect on any response which leads to this stimulus event in the context.
2. Associative strength can accrue from consistent responses in a situation even when the responses do not lead to consistent and uniform sensory experiences.

#### Procedure

Facing the subject was a panel containing 4 buttons (each with its own cover) and 4 lights. Response and light experience were controlled by the experimenter.

128 children were randomly divided into 4 groups. Each group received preliminary training different in terms of response and experience i.e., the response could be the same or vary from trial to trial; while the experience could be presented or withheld for each trial. The acts and experiences for the groups are summarized below:

	<u>Treat- ment I</u>	<u>Treat- ment II</u>	<u>Treat- ment III</u>	<u>Treat- ment IV</u>
Act:	Inconsistent	Inconsistent	Consistent	Consistent
Exper.	Inconsistent	Consistent	Inconsistent	Consistent

At the conclusion of the preliminary training (40 trials) a series of 24 testing trials was given each subject during which all 4 buttons were exposed. The number of responses made to the one button to which the light experience was given permitted a comparison of the effectiveness of each type of treatment.

#### Results

The Treatment Groups (II, III, IV) which had received preliminary training under conditions of consistent act or experience or both, showed a higher proportion of subjects meeting the criterion of learning (44%, 25%, 41% respectively) than did Treatment I Group (.09%) in which there had been no consistency. The significant superiority (.05 level of confidence) of Treatment II Group over Treatment III Group indicated that consistency of experience was more effective in eliciting the requisite behavior change than was consistency of act. Furthermore, when

consistency of experience was present, the presence or absence of a consistent act was immaterial for the response elicitation, tending to validate the assumption of the first hypothesis.

#### Conclusions

An interpretation making use of a feed-back system, initiated by and dependent upon an induced expectation is suggested. Consistent experience contiguous to a given response is assumed to generate an expectation of this experience which can only be fulfilled by it. Thus, it would appear that the consistency of experience brings about the emergence of qualities analogous to those possessed by organic drives.

Microfilm \$2.50; Xerox \$3.60. 63 pages.

#### STUDENT PERCEPTIONS OF TEACHER INFLUENCE

(L. C. Card No. Mic 60-5154)

John Paul Anderson, Ph.D.  
University of Minnesota, 1960

Advisers: Robert J. Keller and  
Ned A. Flanders

The major purpose of this study was to examine the relationships which exist between the dependence of junior high school students and their preferences for teachers who use direct or indirect patterns of influence in the classroom. Secondary objectives were the study of the effect which manipulation of goals might have on students' perceptions of teachers and the relationship which the sex of students bore to the other variables.

A sample of 128 students was selected from a group of 480 students who took part in an experimental learning unit which was designed so that students would be exposed to contrasting patterns of teacher influence, the direct and indirect, and to goal conditions which were either clear or ambiguous. The sample consisted of equal numbers of each sex who had been previously identified as either highly dependent or independent on a scale developed for this purpose. The selection process used for the study thus identified sixteen groups with eight students in each group. There were eight dependent and eight independent girls and similar subgroupings of boys in each of the four experimental treatments. The experimental teacher played the role of a direct teacher in half of the units and an indirect teacher in the other half. Each of these influence patterns was divided equally between units with clear or ambiguous goal conditions.

Student preferences for teachers, their scores on an intelligence test, and their reactions to the various treatments were analyzed by comparing their scores on the following measures: an ideal teacher inventory which measured preferences for direct or indirect teachers;

an instrument which measured students' perceptions of goals as clear or ambiguous; a scale for identifying the influence pattern of the experimental teacher; and the Kuhlmann-Finch Intelligence Test. The comparison of these scores was made through the use of the analysis of variance technique which allowed the writer to test, simultaneously, many different hypotheses.

Specification of the .01 level of significance for rejection of the null hypotheses and the assignment of results between the .05 and the .01 level to the region of doubt produced the following major findings for the several tests of significance:

1. The hypothesis of no differences between groups was rejected for
  - (a) girls and boys on the teacher preference measure
  - (b) dependent and independent students on the goal perception measure
  - (c) direct and indirect treatment groupings on the teacher perception measure.
2. The hypothesis of no difference remained in doubt for
  - (a) dependent and independent students on the teacher preference measure
  - (b) goal perceptions of students in the clear and ambiguous treatments.

3. All other major hypotheses of no differences between groups were accepted with respect to sex, dependence, pattern of influence or condition of goals.

A low reliability and a standard error of measurement which exceeded the mean difference between the teacher preferences of boys and girls on the ideal teacher inventory preclude the making of specific conclusions regarding teacher preferences. The findings of this study suggest that girls and dependent students have a stronger preference for indirect teachers than do boys or independent students.

Dependent students professed a clearer perception of goals in all treatments than did independent students. It would therefore appear that such students are likely to require more help and supervision with their school work since they may not ask for guidance when they need it.

Students can readily distinguish between direct and indirect patterns of teacher influence. Teachers interested in self-analysis may therefore obtain knowledge of their verbal behavior patterns in the classroom by having instruments similar to the teacher perception measure administered to their students.

Microfilm \$2.50; Xerox \$7.80. 169 pages.

## RELATIONSHIP OF PUPIL GAIN IN ARITHMETIC ACHIEVEMENT TO CERTAIN TEACHER CHARACTERISTICS

(L. C. Card No. Mic 60-5571)

Harrell Clark Bassham, Ph.D.  
The University of Nebraska, 1960

Adviser: Charles O. Neidt

The purpose of this study was to investigate the relationship between changes in arithmetic achievement of sixth grade pupils as classified in two levels of intelligence and test scores of several characteristics of their teachers.

Procedure: The relationship between pupil gain in arithmetic achievement and the teacher characteristics was investigated as follows.

Pre-experimental period measures of pupil differences in arithmetic achievement, reading achievement, interest in arithmetic and mental ability were obtained by tests administered early in the fall, following a brief review period. With the exception of the arithmetic interest inventory, all tests were those administered and scored by the teachers as part of the regular sixth grade level testing program. At no time during the investigation was any attempt made to modify existing classroom conditions in any manner.

In March the teachers were administered a test of understanding of basic mathematical concepts, an inventory of attitudes toward methods of teaching arithmetic and a test of interpretation of standardized test results. The teacher's scores on these tests were compared with the post-experimental achievement scores of their pupils after controlling statistically for pupil differences found to exist at the beginning of the experimental period. These relationships were computed for pupils classified as of above class mean intelligence quotient and for pupils of below class mean intelligence quotient, as well as for all pupils as one group. The relationships between change in arithmetic interest scores and achievement were also computed for the two sub-groups as well as for pupils by the total classes.

Subjects included twenty-eight sixth grade teachers and 620 of their pupils. The samples of teachers and pupils were shown to be representative of the total system population of sixth grade teachers and pupils in several important characteristics.

It was necessary to construct the arithmetic interest inventory, the attitudes toward methods of teaching arithmetic inventory and the test of interpretation of standardized test results, as such instruments were not available for use in the investigation. A test constructed by Vincent Glennon of Syracuse University was utilized for evaluating teacher understanding of basic mathematical concepts.

The lack of perfectly valid and reliable tests for the measurement of either pupil or teacher characteristics was an admitted handicap of considerable weight to the investigation. Inability to control a large number of factors influencing pupil achievement also would have been a serious obstacle to such a study if the purpose were determination of true relationships rather than those developing under unmodified classroom conditions.



### Summary and Conclusions:

1. A correlation significant at the one percent level of confidence was found between teacher understanding of basic mathematical concepts and weighted pupil gain in arithmetic for pupils classified as above class mean intelligence. The correlation was not significant as computed for pupils classified as below class mean intelligence. The difference in weighted gain between the two classifications of pupils was also significantly related to teacher scores of understanding basic mathematical concepts.

2. Change of pupil interest in activities involving the use of number was correlated at the one percent level of confidence with weighted gain in arithmetic achievement for pupils classified as of below class mean intelligence. The correlation was not significant with pupils of above class mean intelligence.

3. Teacher scores of attitudes toward methods of teaching arithmetic were not correlated significantly with pupil gain in arithmetic for either classification of pupils.

4. Teacher scores of interpretation of standardized test results were not correlated significantly with pupil gain in arithmetic for either classification of pupils.

Microfilm \$2.55; Xerox \$8.80. 194 pages.

### PARENTAL ATTITUDES IN FAMILIES WHERE CEREBRAL PALSY IS PRESENT

(L. C. Card No. Mic 60-5642)

Herbert Evans Birbeck, Ph.D.  
State University of Iowa, 1960

Co-chairmen: Professor James B. Stroud  
Professor R. R. Rembolt, M.D.

The purpose of this study was to determine whether or not differences exist in the attitudes of parents of children with cerebral palsy and parents with nonhandicapped children in the areas of anxiety, democratic atmosphere in the home, and attitudes toward children and family life. Additional objectives of this study were to determine if changes had occurred in the attitudes of mothers of children with cerebral palsy during the past decade, and to obtain information to provide a basis for improving recommendations programs.

Parents with and parents without children with cerebral palsy were closely matched on the number of children, occupational rating of the father, and on the age, sex, and education of both the mother and father. The experimental and control groups each consisted of ninety-nine mothers and sixty-seven fathers. Results for fathers and mothers were analyzed separately.

The instruments on which the two groups of parents were compared consisted of the California F Scale, The Taylor Scale of Manifest Anxiety, and a modified form of the Parental Attitude Research Instrument which contained five scales for measuring parent attitudes toward children and family life.

The basic design of this study was that of treatments x levels. The treatments were represented by the two groups of parents. The control variable was level of education--college, high school, and grade school. The criterion variables were performance on seven attitude scales.

For fathers, no significant differences were found between the experimental and control groups on the seven attitude scales.

The experimental group of mothers was found to have significantly poorer attitudes, according to the purposes of the tests, than the control group of mothers on the scales of Suppression of Interpersonal Distance, Marital Tensions, Excessive Demand for Striving, and the Taylor Scale of Manifest Anxiety. No significant differences were found between the two groups of mothers on the scales of Over-Possessiveness, Harsh Punitive Control, and the California F Scale.

The attitudes of parents in this study were found to be significantly related to level of education. For fathers, significant differences for levels were found on six of the seven scales. For mothers, significant differences for levels were obtained on five of the seven scales. The results reveal, for the attitudes measured in this study, a consistent trend for better attitudes with increasing level of education for both mothers and fathers.

No significant interaction effects between groups and levels of education were obtained for any of the comparisons made in this study.

The mothers of children with cerebral palsy in this study showed much better understanding of the problems related to cerebral palsy than did the sample of mothers interviewed by Ray in 1951. It is suggested that this difference may be attributed in part to the educational efforts of doctors, nurses, therapists, teachers, and others.

Although the majority of parents of children with cerebral palsy believe they are doing a satisfactory job in carrying out recommendations at home, there is a sizable minority who indicated difficulty with the recommendations. Lack of time, lack of space and equipment, lack of cooperation from their child, and lack of understanding of what they should do seem to be the major problems for these parents.

Microfilm \$4.50; Xerox \$16.00. 351 pages.

### IN-SERVICE GUIDANCE TRAINING FOR NEW JERSEY JUNIOR HIGH SCHOOL TEACHERS

(L. C. Card No. Mic 60-4943)

Paul Vincent Buonaguro, Ed.D.  
Rutgers University, 1960

**Problem.** It was the purpose of this study (1) to explore the principles of in-service training as represented in the literature, (2) to investigate the in-service guidance training practices in New Jersey junior high schools, and (3) to suggest procedures relative to an in-service guidance training program for teachers in the Cranford Junior High Schools specifically, and in New Jersey junior high schools in general.

**Procedures.** The ninety approved junior high schools in New Jersey were included in an initial inquiry by mail. This brief inquiry explained the reason for the proposed study, and requested information on whether or not each school had in-service guidance training practices for teachers and was willing to complete a questionnaire on the subject. The inquiry was addressed to the principal of

each junior high school, and answers were received from all ninety of them.

Thirty-two schools identified themselves as having such practices and willing to participate in the study. The questionnaires sent to these schools were all returned, and the responses were quantified in tables and by descriptive reports.

The items in the questionnaire were based on the review of related literature and the varied experiences of the investigator in the field of education. The items were subjected to critical evaluation by colleagues and officials of other school systems and to repeated refinement by students in graduate seminar.

**Conclusions.** Junior high school principals expected most of their teachers to perform duties which included practically the whole range of guidance services.

Approximately one-third of the approved junior high schools in New Jersey conducted in-service guidance training practices for teachers.

The most important in-service guidance training practices for junior high school teachers were as follows: Case Conference, Consultant Services, Faculty Meeting, Guidance Conferences and Conventions, Teacher Referrals, Guidance Bulletins for Teachers, Guidance Committee, Professional Library for Teachers, Apprenticeship, and Manual for Teachers.

The Faculty Meeting was the only practice for in-service guidance training used by every school.

Child Growth and Development, Psychology of Adolescence, and Principles of Guidance were considered the most significant professional course work areas for in-service guidance training for teachers.

Determining individual needs, Interpreting pupil data, Pupil counseling, and Teacher-parent relationships were on-the-job areas of greatest significance for in-service guidance training for teachers.

The evaluation of in-service guidance training practices for teachers was limited and subjective in nature.

**Implications.** A committee on in-service guidance training should be appointed to emphasize the role of guidance in the junior high school.

Well-prepared guidance manuals and bulletins should be available for teachers in the junior high school.

A professional library should be established in each junior high school with a selection of books in the various areas of guidance.

The resources of local colleges and universities should be used for in-service guidance training. Catalogues should be made available, and significant professional course work offerings identified in this study should be called to the attention of the staff.

On-the-job areas recognized as of utmost need could be effective points of departure for launching meaningful in-service guidance training practices for teachers.

The practices reported in the study should be used in effective combinations to meet the individual and group needs of the staff.

Continuous objective evaluation of the in-service guidance training practices for teachers should be the responsibility of all concerned.

**Recommendations for further study.** The results of this study suggested a number of areas that needed further research:

Validation of criteria on the effectiveness of in-service guidance training practices for teachers.

Staff attitudes toward in-service training for teachers.

Follow-up studies on the value of professional course work in guidance for teachers in service.

The function of a state department of education in relation to in-service guidance training for teachers.

Microfilm \$2.50; Xerox \$5.80. 120 pages.

#### EVALUATION OF INDEPENDENT STUDY IN COLLEGE COURSES

(L. C. Card No. Mic 60-5157)

Ruth Dietz Churchill, Ph.D.  
University of Minnesota, 1960

Having students assume more responsibility for their learning may help solve the problem of improving higher education while training increasing numbers of students. With this purpose in view, lecture-discussion was compared with two methods of independent study--small groups and individual work--in seven representative first-level general education courses at Antioch College. In both independent-study methods class time was reduced roughly one half; students were trained and given material to guide the independent-study method they were to follow. In only one course was registration large enough to teach sections by lecture-discussion and both experimental methods. In the other six, the lecture-discussion approach was compared with one of the two experimental methods. One instructor taught all sections of each course; content and other features of the course were the same for all students.

The subjects were all students enrolled in the courses studied; they were randomly assigned to treatments. Except for a higher proportion of women, freshmen in the experiment were typical of Antioch freshmen.

The basic statistical procedure was analysis of variance or covariance. Analysis of covariance was used where necessary to control differences in background among sections within a course or to take account of correlation between pretest scores and gains. Results were expressed as posttest scores or gains, as appropriate. Each major hypothesis was tested in two steps. The first subhypothesis was that for all the courses as a group, within each course sections taught by different methods did not differ. Since the measures of course-related achievement were specific to each course, Fisher's procedure for combining independent tests of significance was substituted for analysis of variance for these measures. If this subhypothesis was rejected, the second was tested--that within each course separately sections taught by different methods did not differ.

In all courses all sections gained substantially and significantly in achieving course objectives measured by multiple-choice tests. For the courses as a group, sections taught by different methods did not differ in gains on these tests. In five of the seven courses sections taught by different methods did not differ in performing instructors' assignments. In one course students working individually surpassed the lecture-discussion class on these tasks while in a second course the differences were reversed. The most plausible explanation for these contradictory results was that instructors' biases for a particular method



affected their grading of assignments. Thus, method of teaching was not related to differences in course achievement.

Gains in skills and attitudes favoring independent study were irregular, slight, and generally nonsignificant. For the courses as a group, sections taught by different methods did not differ on the test of skill or the five scales of the California Psychological Inventory used to measure attitudes.

Students were satisfied with instructors and courses and with lecture-discussion; they tended to be dissatisfied with both methods of independent study. For the courses as a group, sections taught by different methods did not differ in satisfaction with courses and instructors but did differ in satisfaction with the teaching method used. The lecture-discussion approach was always rated higher than either method of independent study, in five courses significantly so. Students did not differ significantly in satisfaction with the two methods of independent study.

Since all teaching methods led to similar substantial gains in course achievement, serious doubt is cast on definitions of time needed in the classroom, and independent-study methods appear to be as useful as lecture-discussion, provided that independent study can be made more acceptable. Microfilm \$3.40; Xerox \$11.95. 262 pages.

#### THE RELATIONSHIP BETWEEN PARENTS' AWARENESS OF THEIR ADOLESCENT CHILDREN'S PROBLEMS AND THE AFFECTIVE ADJUSTMENT OF THOSE CHILDREN

(L. C. Card No. Mic 60-5220)

Theodore John Cote, Ph.D.  
The University of Connecticut, 1960

##### Purpose of the Study

This study was concerned with whether significant changes in the affective adjustment of adolescents could result from informing parents of the nature of their children's problems. Primary emphasis was directed toward adolescent feelings regarding: presence of problems, symptoms of desirable adjustment and preference for personal activities.

##### Research Procedures

The subjects for this experimental study were ninety mid-adolescent students of a vocational-technical school in a Connecticut industrial city of over 100,000 population.

The students were allocated to three random groups and the Mooney Problem Check List, Heston Personal Adjustment Inventory and Kuder Preference Record-Personal were administered to each of the groups two months before the end of the school year.

The Mooney was also administered to the parents of one of the student groups with instructions that they respond as they felt their children would. Comparison graphs were prepared showing the parent's and the children's results and these were mailed to the parent with instructions

that they try to assist their children with the problems as indicated in the report.

A letter listing the problem areas and the number of problems checked in each by their children was sent to the parents of the second group. Again the parents were instructed to try to help their children with their problems as indicated in the letter. The third group of students served as a control group.

The same battery of tests was administered to the total group of students at the end of the school year and again following the summer vacation.

Change scores were computed for each group over the various time periods and the differences in the changes between groups were cast in four-cell contingency tables and the significance tested by the one-tailed Chi-Square test.

##### Results of the Study

Through the use of the above procedures it was found that significant differences occurred in five of the twenty-two areas of adjustment considered in the study. These areas were: Adjustment to school work, Sociability, Personal Relations, Preference for working with ideas and Preference for being active in groups.

##### Conclusions

1. Informing parents of the nature of their children's problems can result in significant changes in their affective adjustment.
2. The changes can be in either negative or positive directions.
3. The changes may persist for varying periods of time.
4. The direction and permanence of the change are apparent functions of the technique used in making the parents aware of the problems.

Microfilm \$2.50; Xerox \$5.20. 105 pages.

#### THE INFORMAL ORGANIZATION IN A RESIDENCE HALL COUNSELOR ORGANIZATION

(L. C. Card No. Mic 60-5424)

William Bowen Crafts, Ed.D.  
The Pennsylvania State University, 1960

A study of the informal organization of the Residence Hall Counselors at The Pennsylvania State University was conducted by the director of the organization during the period from September 1959 to mid-April of 1960. The concept "informal organization" refers to the attitude and behavior patterns which develop informally and spontaneously among individuals who are associated in an undertaking. These patterns arise out of, and are inseparable from the formal organization--the realm of official job duties and procedures. The investigator's purpose was to determine in what ways the counselors' attitude and behavior patterns supported, diverted or undermined the manner in which the counselorship and its responsibilities was officially described.

Essential steps taken prior to the start of the study included conducting a pilot study and re-appraising the official duties and responsibilities of the counselorship. It was also necessary to train the Coordinators, the men immediately in charge of the counselors in each of the three living areas (Nittany, North or West Halls), as participant observers of counselor interactions.

Data was gathered mainly by means of three questionnaires, administered early in September after a brief training period for counselors, in November, and in March of 1960. A substantial amount of data also was contributed by the Coordinators. The investigator concluded the study by holding personal interviews with the counselors.

The informal organization functions to promote: communication among the members (Intra-action), cohesiveness of attitude and behavior, independence of the individual member from the dictates of the organization (Individualization), and leadership within the group.

As regards communication (Intra-action), the newly-appointed counselors were quickly made aware of the experienced counselors' opinions on many job-related topics during the September training period. The likelihood also was established that confidential information about an impending administrative change of concern to counselors would be communicated quickly throughout the organization.

Regarding Cohesiveness within the organization, evidence of uniformity of conduct and attitude was demonstrated primarily within the area group, since the members tended to have frequent contacts only with area colleagues. Many counselors, especially those in the Nittany group, were not favorably inclined toward several cooperating University Services, as evidenced by serious intra-group "gripping" and critical attitudes being transmitted to their students. Under conditions which they perceived as threatening to their welfare, the counselors in all three groups were capable of a highly excitable and uniform reaction.

The Nittany counselors, working under conditions with which they grew increasingly dissatisfied, had a particularly strong bond among them and were motivated by commonly-shared conceptions of the need for counselor cooperation and the challenge they visualized in the work. Several norms of behavior were identified late in the study. A counselor would likely be informed of his colleagues' disapproval if he should fall down persistently in the job, or if he should set a poor example, or if he should not cooperate with associates in an important matter.

The evidence of Individualization took several forms, such as seeking the companionship of nearby counselors if overbearing job responsibilities caused them to become very discouraged. The counselors were inclined to explain their application to the work in terms of individual interpretation and judgment rather than requirements established by the Dean's Office.

Regarding the aspect of Leadership, the experienced members were looked to for information, guidance and friendship during the early fall, but their influence diminished as the new appointees became oriented to the counselors' work.

It was concluded that, in general, the attitudes and actions of the informal organization supported the objectives of the formal organization. The results of the study implied that the informal organization had caused the

organization to function in a different manner from one area to another and that the Coordinator was the chief figure within the area group, helping to fuse the needs of the informal and the dictates of the formal organization. In some instances, counselor behavior that was not approved by the formal organization tended to be sanctioned by one's associates.

Microfilm \$2.95; Xerox \$10.15. 225 pages.

# A STUDY OF THE DISCRIMINATION EFFECTIVENESS OF THE STERN ACTIVITIES INDEX WITH ACHIEVEMENT GROUPS IN PURDUE'S FRESHMEN ENGINEERING PROGRAM

(L. C. Card No. Mic 60-6100)

Robert LaFollette Crist, Ph.D.  
Purdue University, 1960

Major Professor: Lee E. Isaacson

The primary purpose of this study was to investigate whether a liking or disliking of specific activities as contained in the Stern Activities Index would serve to predict academic performance among freshmen engineering students at Purdue University. The criteria of academic performance were over-achievement and under-achievement, high and low grade point average, and staying in the engineering program versus withdrawal or transferring. There were 370 freshmen engineering students in the original experimental group.

Composite scales were developed containing items from the Activities Index which had been found to differentiate between the subjects in the three above criterion groups. These composite scales when used with two cross-validation groups were not found effective in differentiating over-achievers from under-achievers, high grade point average students from low grade point average students, and students who stay in engineering from those who withdraw or transfer.

These composite scale scores were also correlated with various measures of intellectual ability. No significant relationship was found to exist between the scale scores and the measures of intellectual ability employed.

An analysis of the individual items comprising the composite scales was made. The information thus obtained seemed to indicate that students in the freshmen engineering program who over-achieve, stay in engineering, and achieve high grades like those activities which require mental effort and provide information about the physical world. Those students who under-achieve, leave the engineering program, and achieve low grades, like activities which are concerned with interpersonal relationships. They like people and are concerned with what people think of them.

Microfilm \$2.50; Xerox \$7.00. 149 pages.



# DIRECTOR RECOMMENDATIONS FOR NATIONAL DEFENSE COUNSELING AND GUIDANCE TRAINING INSTITUTES

(L. C. Card No. Mic 60-4944)

Irving Eisen, Ed.D.  
Rutgers University, 1960

## Introduction

In the summer of 1959 fifty Counseling and Guidance Training Institutes were conducted in accordance with Title V-Part B of the National Defense Education Act of 1958. It was the general purpose of the study to explore the recommendations of a group of individuals intimately involved with Institutes, Directors of the 1959 summer Institutes, to discover what changes they recommended.

## Problem

The current study reported, analyzed, and interpreted data concerning the extent to which certain recommendations made by individual Directors in their technical reports to the U.S. Office were acceptable to all fifty Directors. Recommendations included those related to the following areas: Title V-Part B of the Act, the role of the U.S. Office of Education in administering the Institutes program, planning and structuring of Institutes, the actual conduct of Institutes, and evaluation studies.

## Techniques Used and Sources of Data

The Act, some important public discussion material concerning the Act, administrative statements by government officials, and directly related literature of counselor training were reviewed. Technical reports of Directors on file in the Counseling and Guidance Institutes Section of the U.S. Office were then surveyed to discover specific recommendations which were, in fact, submitted. These recommendations were then submitted in a questionnaire for the reconsideration of all fifty Directors. Responses were received from all Directors.

## Findings and Conclusions

Questionnaire responses indicated that the following recommendations warrant consideration:

- 1.) The scope of Institutes should be broadened to include training for the guidance of all students rather than able students only. Elementary school personnel would also be eligible.
- 2.) Deletion of the loyalty oath and affidavit requirement should be considered.
- 3.) NDEA funds should be available for self-evaluation studies by Institutes.
- 4.) Directors indicated that they wanted the U.S. Office of Education to continue a role of leadership in the Institutes program by facilitating the exchange of information and insights through conferences, through publication of a bulletin, and through development of an evaluation instrument for use by Institutes on a voluntary basis. In matters affecting local autonomy, Directors agreed that the U.S. Office should provide for flexibility and reliance upon the professional judgments of Institute Directors.
- 5.) Directors failed to attribute importance to including

officials administering Title V-Part A state plans as part of an Institute planning committee. There was agreement that local school guidance workers should participate in the planning.

6.) Recommendations related to structuring short-term Institutes suggested that terms coincide with the sponsoring institution's summer session (6-9 weeks in length), enroll 25-50 persons, and provide certain minimum physical facilities. There was a tendency to favor training journeymen counselors from the local area. Advanced enrollees should hold a Master's degree or state guidance certification, but beginning Institutes need require little or no guidance prerequisites. Repeated references were made to the need to consider local conditions and needs.

7.) Training programs and practices were considered to require emphasis on practicum for advanced counselors, and emphasis on individual conferences and small-group work for beginners. Eliciting complete personal data to facilitate adapting programs to individual differences was indicated as important.

8.) Staffing recommendations suggested that the Director be a full-time person, participate in instruction, and be assisted by key staff members having the highest possible qualifications as counselor trainers.

9.) A consultant or guest lecturer can make his optimum contribution if engaged for a full day, at least, to cover a specific topic.

10.) The need for evaluation studies was regarded as very important and indicated that careful decision-making toward effective division of evaluation responsibilities was necessary. Microfilm \$2.50; Xerox \$7.80. 167 pages.

# SOME EFFECTS OF READING ABILITY ON GROUP INTELLIGENCE TEST SCORES IN THE INTERMEDIATE GRADES

(L. C. Card No. Mic 60-5653)

Louis Allen Fitzgerald, Ph.D.  
State University of Iowa, 1960

Chairman: Professor William Eller

This study was conducted in seven school systems of Jones County, Iowa in the spring semester of 1960.

The children enrolled in grades four and six were given the Gates Reading Survey, the Otis Quick-Scoring Mental Ability Test, and the verbal battery of The Lorge-Thorndike Intelligence Tests.

For this study retarded readers were defined as pupils reading below their grade placement. The group tests were given in late February and early March. Gates assigns a value of +.6 to the grade number for this time of year. Therefore, the pupils were considered to be in grades 4.6 and 6.6 at the time of testing.

Pupils reading below grade placement were selected to form groups having mean reading grades of 6.1, 5.6, 5.1, and 4.1 for grade six, and mean reading grades of 4.1, 3.6, 3.1, and 2.6 for grade four. It was not possible to select a group reading two and one half years below grade placement for grade four. Two normal groups were selected as control groups having mean reading grade placements of 6.6 and 4.6.

Since the purpose of the study was to observe the discrepancy values between group intelligence test scores and true intelligence of children classified as retarded readers some estimate of the true score was needed for each child. The Wechsler Intelligence Scale for Children was chosen for this purpose. The total number of Wechsler Tests given was 185, but eight were eliminated to provide the appropriate group means of reading. Therefore, 177 were used in the study.

Subtraction of the Wechsler score from the group intelligence test score provided a discrepancy value for each child, and this was done for each of the two group intelligence tests. Four sets of mean discrepancy values were available for analysis. They were the Wechsler - Otis discrepancies for grade six, the Wechsler - Otis discrepancies for grade four, the Wechsler - Lorge-Thorndike discrepancies for grade six, and the Wechsler - Lorge-Thorndike discrepancies for grade four.

Analyses of variance were used to study the significance of the differences found in the group means. Each of the four sets of data was subjected to the analysis of variance technique plus the combined values for grades four and six for each of the group tests.

The hypothesis of homogeneity of the means was retained for the Wechsler - Otis discrepancies for grade six, but rejected for each of the other five comparisons.

The t-ratio was used to study the differences in group discrepancy means within each set. Statistically significant differences were found for at least the differences between the normal and most retarded readers for each set except the Wechsler - Otis values for grade four. In this latter case the maximum discrepancy value was found for the pupils reading one year below grade level. The group of pupils two years below grade in reading produced discrepancy scores having a mean value almost identical to the normal reading group. This appeared to be an artifact of the Otis Test.

Each of the four sets was sufficiently dissimilar from the others to allow a meaningful composite. A generalized description of the size of the discrepancy for a specified amount of reading retardation could not be made.

The data presented in this study support the belief that children retarded in reading earn scores on group intelligence tests that are lower than their ability levels would indicate they should earn. The scores of the four sets of data failed to agree sufficiently to allow predictions for the various amounts of reading retardation.

Microfilm \$2.50; Xerox \$4.60. 86 pages.

#### A SCALE FOR MEASURING TEACHER CLASS CONTROL AND ITS RELATION TO PERSONALITY

(L. C. Card No. Mic 60-5434)

Florence Kilgore Gaberman, Ph.D.  
The Pennsylvania State University, 1960

The investigation of teacher effectiveness has been the subject of literally thousands of studies. The accumulated evidence supports the need for studies of specific and clearly defined aspects of the teaching process. The present study had as its focus the ability of a teacher to

control a class in a manner which supports an atmosphere in which learning can occur. The frequency with which discipline or control is mentioned as a critical ability in teacher evaluation studies is evidence that it is a variable meriting careful study.

The present study was designed (1) to develop a measure of the ability of teachers to control a class effectively and (2) to identify some personal characteristics related to this ability. It was assumed that this aspect of teacher performance could be observed in the behaviors of teachers in classrooms. Flanagan's critical incident technique was used to develop a list of behaviors which were judged to be crucial in achieving effective control. A group of 51 educators provided a total of 172 incidents which described observable behavior which they considered to reflect this class control variable. Summary statements of the teacher behavior described in the incidents were formulated and edited, leaving 116 statements which became the Teacher Behavior Rating Scale (TBRS).

The subjects were 105 student teachers at a large eastern university who completed their student teaching during the semester in which the study was conducted. Each student was rated by the "cooperating teacher" in whose classroom and under whose immediate supervision he had completed nine weeks of student teaching. Twenty cases were selected for a test-retest reliability study, with the original rater completing the second rating after a two-week interval. The product-moment correlation between the two ratings was +.82. An item analysis of the scale identified 24 items which did not correlate significantly with the total rating. When the scale was rescored with these items eliminated, virtually the same measure was obtained ( $r \frac{1}{2} + .997$ ).

In an attempt to identify personality variables which might be related to the kind of behavior measured by the TBRS, a battery of personality tests was administered to the subjects. The battery included the F-scale, the Minnesota Teacher Attitude Inventory, the Minnesota Multiphasic Personality Inventory (MMPI) and the Guilford-Zimmerman Temperament Survey. The subjects were divided randomly into two groups and product-moment correlations were computed between scores on the scales in the personality battery and the TBRS. In Group I six scales, Ascendence, Sociability, Emotional Stability (G-Z), Hypochondriasis, Depression and Psychasthenia (MMPI), showed a significant correlation ( $p < .05$ ) with the TBRS. None of these six scales showed a significant relationship with the TBRS in Group II. It was therefore concluded that no relationship had been demonstrated between the personality measures and class control as assessed by the TBRS. The replication was significant in demonstrating that conclusions, that might well have been drawn from the analysis of the first group alone, were indefensible.

Microfilm \$2.50; Xerox \$4.20. 79 pages.



# A COMPARISON OF THE READING DIFFICULTY OF VOCATIONAL AGRICULTURE REFERENCE BOOKS WITH THE READING ABILITY OF THE STUDENTS USING THEM

(L. C. Card No. Mic 60-6108)

Robert Edward Galloway, Ph.D.  
Purdue University, 1960

Major Professor: Ralph R. Bentley

## Purpose

This study was designed to compare the readability of certain vocational agriculture reference books with the reading ability of the students using them. In order to make this comparison it was necessary to measure both the readability of reference books and the reading ability of vocational agriculture students.

## Procedure

The basic information for this study included readability measurements for ten vocational agriculture reference books and measurements of reading and mental ability for 760 students of vocational agriculture in the four high school grades of the cooperating schools.

Students were tested in one relatively large and one relatively small high school in each of the twelve vocational agriculture districts in Indiana. The Cooperative English Tests, Test C1: Reading Comprehension and the Iowa Tests of Educational Development: Test 6, Ability to Interpret Reading Materials in the Natural Sciences were used to measure reading ability. The Verbal Battery and the Nonverbal Battery of the Lorge-Thorndike Intelligence Tests series were used to determine the mental ability of these students.

Ten reference books were chosen for the readability measurement from those found to be available in large enough quantities for class use in the libraries of the cooperating schools. The Dale-Chall Readability Formula was used for the measurement of book readability.

The analysis of variance was used to test for significant differences in readability of the ten books and the reading and mental ability of the students in twenty-two cooperating schools. When significant differences were found, the readability was expressed in mean and standard deviation grade levels for each book. Students' scores for each test were also expressed as mean and standard deviation grade level units and were calculated for individual schools and/or groups of non-differing schools depending on the results of significance tests. Means and standard deviations of readability were then compared with means and standard deviations of reading ability.

## Conclusions

The following conclusions were drawn for the agricultural reference books and the vocational agriculture students in this study.

1. Each of the vocational agriculture reference books had a mean readability appropriate for students of average reading ability in one of the four high school grades.
2. Vocational agriculture students had mean reading abilities which ranged from zero to three grade levels below their peers on the basis of publishers' norm groups.

3. Students of vocational agriculture scored from one to two grade levels higher on the test of reading in the natural sciences than they did on the general reading test.

4. Although there was wide variation from school to school in the mental ability of vocational agriculture students, in general, their mental ability was similar to that of their peers as represented by the publisher's norm groups.

5. Twelfth grade students, especially those in large schools, were characterized by their low reading ability.

6. In general, reading ability did not differ with respect to school size and location.

7. In general, verbal mental ability did not differ with respect to school size and location.

8. Nonverbal mental ability varied widely among individual schools.

9. Reading ability varied widely both among vocational agriculture classes and within classes at a given grade level.

10. In general, the agricultural reference books used by the students of vocational agriculture tended to be too difficult for their reading ability.

## Implications

It seems apparent that careful consideration should be given to the reading ability of vocational agriculture students when choosing reference books for their use. In view of the variation of reading ability within vocational agriculture classes, it also seems unwise to use a single reference book on a given topic. Further, it might be well to train teachers of vocational agriculture in the basic principles of reading instruction.

Microfilm \$2.50; Xerox \$7.60. 163 pages.

# A COMPARISON OF SELECTED ASPECTS OF SELF-CONCEPT AND CERTAIN OTHER PERSONALITY CHARACTERISTICS OF "EFFICIENT" vs "INEFFICIENT" ACADEMIC ACHIEVERS IN THE FOURTH GRADE

(L. C. Card No. Mic 60-5133)

Fain A. Guthrie, Ed.D.  
The University of Florida, 1960

## Procedure

This study was designed in terms of a theory of human behavior which holds that behavior is a function of the perceptions an individual has of himself and his environment. Perception was defined as the personal meaning the experience of oneself, circumstances, ideas, or any aspect of the physical or psychological environment has for the perceiver.

The basic problem was the differential investigation of certain perceptions held by two groups of fourth grade boys who showed different levels of academic achievement. The two experimental groups contained thirty subjects each. The groups were not different with respect to:

1. Race
2. Socio-economic status
3. Chronological age

4. Actual grade placement
5. Sex
6. Mental age

They were significantly different with respect to academic achievement, as measured by standardized tests.

Each student of the first group had an educational age at least one year above his mental age. This group was called the "efficient" achievers. Each student of the second group had an educational age at least one year below his mental age. These were called the "inefficient" achievers.

The types of perceptions generally held to characterize the "healthy" personality were described. It was hypothesized that the "efficient" achievers would have "healthier" perceptions than would the "inefficient" achievers with respect to:

1. Self
2. Peers
3. School
4. Parents

A fifth hypothesis was:

5. Teachers will judge "efficient" achievers as emotionally "healthier" than the "inefficient" achievers.

A Picture-Story Test was designed to test hypotheses 1, 2, 3, and 4. It depicted situations planned to elicit stories from which the perceptions used as variables might be inferred. Each student was free to reveal his perceptions of:

1. Self in school
2. Self in home
3. School
4. Peers
5. Parents

A scoring technique was designed which allowed each inferred perception to be scored as either positive, negative, or neutral. Also each perception could be scored as to the "strength" of feeling. Both the inter-judge scoring reliability and the rescore reliability of this method proved significant beyond the .01 level.

All subjects responded to each picture. The differences between groups in number of perceptions judged positive, neutral, and negative were tested by chi-square. Mean differences in strength of perceptions shown by the groups were tested by "t."

A check list was constructed on which the teacher of each child could report her judgments of the child in terms of several personality factors. The judgments of teachers were analyzed by "t" in terms of mean group differences. Teacher judgments were then correlated with the perception scores obtained from the students on the picture-story test.

#### Results

1. Both groups showed many more negative than positive or neutral perceptions of self, school, peers, and parents.
2. There were no significant differences between number of positive, negative, or neutral perceptions held by the two groups on any variable.
3. There was a definite trend in the "inefficient" group

toward stronger negative feelings on all variables. This difference for total perceptions was at the .14 level.

4. Teacher judgments differentiated between the two groups beyond the .001 level. The "efficient" achievers were judged emotionally "healthier."

5. Teacher judgments of the children were not significantly correlated with the perceptions students of either group held of themselves.

#### Discussion

The results were discussed as follows:

1. Possible overcompensation by the "efficient" achievers.
2. The tendency of projective tests to elicit negative feelings commonly inhibited by most individuals.
3. The lack of a well-structured "healthy" frame of reference on the part of the analyzing psychologists.
4. The possibility that no individual ever achieves a perfectly "healthy" emotional state. Most persons seem to reach a functionally satisfactory condition, but this falls short of complete mental health.

Microfilm \$2.50; Xerox \$6.40. 135 pages.

#### BACKGROUND OF VOCATIONAL CHOICE IN A DENOMINATIONAL UNIVERSITY

(L. C. Card No. Mic 60-4546)

Lannes Homer Hope, Ph.D.  
The University of Texas, 1960

Supervisor: Dr. Royal B. Embree, Jr.

The purpose of this study was to examine the relationship of vocational choice of college freshmen students to self-structure and home background, as reported, and values and antidemocratic tendencies, as measured. The five sample populations were composed of freshmen male students of the same religious preference at a private, denominational university, who had made preliminary vocational choices of Pre-Law, Pre-Medicine, Pre-Seminary, Arts and Sciences, and Undecided. Three representations of self (self-ratings) were obtained to estimate self-structure. These ratings of self-concept, self-acceptance, and self-ideal were made on words which had been placed in categories descriptive of seven aspects of personality. Measures of antidemocratic tendencies, values, and value orientation were obtained, as well as reports on home and church background. Analysis of variance of responses indicated significant differences among sample populations on these variables.

The Pre-Seminary students tended to be more anxious and more antidemocratic in nature. The parents of this group were from the lower middle class or upper lower class, and were reported as being relatively inactive in church affairs. Responses of the Undecided students were the highest in antidemocratic tendency and the lowest on most self-ratings. This low representation of self indicated a different kind of Undecided student from that described in a similar study at a nondenominational



university. Mothers of the Undecided students were reported as being more active in church affairs than the fathers, although this was also reported to a lesser degree by students of the other four sample populations.

The general findings of this study indicated that there were significant differences among the sample populations in representations of self and in reports of home background; there were significant differences among sample populations on values and antidemocratic tendencies as measured; and there were no differences in academic achievement and aptitude as measured.

Microfilm \$2.50; Xerox \$7.60. 163 pages.

#### ORGANIZATION AND ADMINISTRATION OF THE GUIDANCE-PERSONNEL PROGRAM IN A CAMPUS-TYPE HIGH SCHOOL

(L. C. Card No. Mic 60-4947)

Jack Vincent Irion, Ed.D.  
Rutgers University, 1960

##### Introduction

The campus-type high school with its "school within a school" environment and physical set-up provides the specialized facilities and comprehensive program that help vitalize the education process. The problem of the organization and administration of the guidance-personnel program in a new campus-type high school is a most pertinent one if the program is to assist the school in educating and stimulating the individual to make the most of his potentialities and become a contributing member of a democratic society.

##### Design of the study

The design of this study was (1) to analyze the existing guidance-personnel programs in campus-type high schools; (2) to establish a frame of reference within the educational program and community life of Bridgewater Township for the guidance program in a new campus-type high school; and (3) to develop the guidance-personnel program for Bridgewater-Raritan High School.

##### Procedures

Thirty-one campus-type high schools reported on the Inquiry Form, and those operating in New Jersey were visited. The history of Bridgewater Township relative to its educational and community life was investigated.

##### Findings and conclusions

###### Campus-type high school programs-

The campus-type organization allows for a close teacher-pupil relationship and a fine team approach to guidance.

Campus-type high schools have been organized according to subject areas, student classes or grades, and the small school plan. The class organization appears to be the most common.

A ratio of approximately four hundred pupils per full-

time counselor was indicated for the schools participating in the study.

Teachers, it was found, cooperate actively in guidance-personnel functions in campus-type high schools.

Meaningful differentiation in counselor responsibilities was found. In addition to the responsibilities to their specific grade or "house" counselee load, duties varied among the schools' counselors in terms of specific tasks.

The study found that the person in charge of the guidance-personnel program was responsible for almost an unlimited number of services and activities.

###### School community-

It was found that the Bridgewater Township school community was principally a suburban residential area with several large industries, many of which were of a scientific research nature. Industry offered the advantage of providing employment for residents and of shouldering a heavy share of the tax load. The school system was the largest one in Somerset County, New Jersey, and the members of the community played an active role in the development of the educational program and of the school plant facilities for the four year, 1,500 pupil capacity high school.

###### Implications for Bridgewater-Raritan High School-

A full-time counselor for each of the four grades should be housed in the school, in addition to a full-time director of guidance.

Male and female personnel should be included on the guidance staff.

The counselors should be directly responsible to the director of guidance, with the director responsible to the high school principal.

The equivalent time of one and a half secretaries should be provided in the guidance office.

Counselors should be available to parents during the regular school hours and at regularly scheduled times in the evening.

A citizens guidance advisory committee should be organized to secure suggestions and opinions and to help develop community cooperation in the guidance-personnel program.

##### Recommendations for further study

A study of the total educational program in the campus-type high school.

A follow-up study evaluating the effectiveness of the proposals resulting from the present study.

A job-analysis of the person in charge of the guidance program.

An in-service education program for school staff members and their participation in the guidance program.

Microfilm \$2.50; Xerox \$5.40. 108 pages.

**A STUDY OF THE ACADEMIC ACHIEVEMENT,  
CHILDHOOD DISEASES, AND THE HISTORY OF  
DELINQUENCY IN RELATION TO THE ONSET  
OF HEARING LOSS AMONG A GROUP OF  
HARD-OF-HEARING DELINQUENT CHILDREN.**

(L. C. Card No. Mic 60-4549)

William Emmett Johnson, Ph.D.  
The University of Texas, 1960

Supervisor: William G. Wolfe

When 889 individuals, residing in state schools for juvenile delinquents in Texas, were given hearing tests using the pure tone audiometer, it was discovered that 115, or 12.9 per cent, of the juvenile delinquent population in residence had a medically significant hearing loss. Persons were considered to have a medically significant hearing loss if they failed to hear, in either ear, any two of the six frequencies presented at a loudness level of 20 decibels, or any one of the frequencies at 30 decibels. The six frequencies used were 250, 500, 1000, 2000, 4000, and 6000 cycles per second. Research results reported in the literature indicate that when the above criteria were used in evaluating the hearing acuity of large groups of children of school age, it was noted that only 4.5 per cent of the children in the general population were found to have medically significant hearing losses. There was a need, therefore, of a comprehensive and analytical study to attempt to determine the reason for this discrepancy between the hearing acuity of juvenile delinquents and that of the general school population.

The results of this study indicated that 50.1 per cent of the delinquents with a medically significant hearing loss had a perceptive loss in either the right or left ear or in both ears. A total of 44.3 per cent of these individuals were found to have a perceptive loss in both ears. It also was noted that 37.4 per cent of the sample population had a conductive loss in the right or left ear, or in both ears, whereas only 19.1 per cent had a mixed hearing loss.

Fifty-eight of the delinquents, or 50.3 per cent of the sample population, attended school at one time during their school careers in the six largest school systems in the State of Texas. Although several of these districts had special classes for the deaf and/or hard-of-hearing at the time the individuals in the sample population were attending school in the community, there was no indication that any of the individuals were recommended for placement in a special class for the deaf and/or hard-of-hearing.

Available records indicated that only 37 individuals, or 32.2 per cent of the sample population, had received a hearing test while attending school in their home community. Twenty of these delinquents were reported as having a hearing loss at the time of the school examination.

Truancy, as a reason for commitment to the state schools for juvenile delinquents, more frequently was found in the case of delinquents with medically significant hearing losses than among the general population of juvenile delinquents residing in the state schools of Texas. This fact was particularly true in the case of the female juvenile delinquent.

Delinquents having medically significant hearing losses, as a group, were committed to a state school at an earlier age than were delinquents having no evidence of a hearing

problem. The median age, at time of admission, for all male delinquents was 15 years, 7 months. The median age, at time of admission, for male delinquents with medically significant hearing losses was 15 years, 2 months. The median age for all female delinquents, at time of admission, was 15 years, 6 months, whereas the median age, at time of admission, for female delinquents with a medically significant hearing loss was found to be 14 years, 9 months.

The results of this study indicate that hearing problems seem to be more prevalent among individuals who have been classified as juvenile delinquents than among individuals who give indications of having made a satisfactory adjustment to the demands placed upon them by our society. These findings suggest a need for establishing a systematic plan for case finding of individuals with hearing disabilities. The general findings of this study point out the need for standardizing methods of testing and establishing criteria for referral of acoustically handicapped children for otological examinations. A concerted effort also must be made to see that these individuals receive the necessary care and treatment, be that treatment a hearing aid, medical attention, lip reading, or placement in a special class for hard-of-hearing children. If these individuals with medically significant hearing losses, located by means of this study, had been given the help and attention they needed early in their school careers, many of them possibly would not be residing in state schools for delinquent children at the time of this study.

Microfilm \$2.50; Xerox \$6.00. 124 pages.

**THE RELATIONSHIP OF SPECIFIC ASPECTS  
OF ART PICTURE JUDGING TO SOME  
PERSONALITY VARIABLES OF THE JUDGES**

(L. C. Card No. Mic 60-5446)

Earl William Linderman, Jr., Ed.D.  
The Pennsylvania State University, 1960

Statement of the Problem

This study was an endeavor to investigate some possible relationships between over-all quality art judgments of art educators and non-art personnel, and some factors which may have been operating as influences on their judgments of art products.

The Population

The population used in the investigation consisted of the following two groups: (1) a graduate group consisting of art education instructors at the college and public school levels; N:20, and (2) a graduate group consisting of non-art instructors and students selected from other disciplines; N:20.

The Procedure

In an effort to arrive at some understanding concerning the problem of judgment in art education research, several personality characteristics were studied: (1) temperament,



(2) judge-attitude, (3) independence or yielding of judgment, (4) some biases of judges, (5) authoritarianism, and (6) aesthetic judgment.

In conjunction with the above variables, the initial purpose of the research was to determine if clustering occurred among art education judges. The procedure involved the ranking of 10 art pictures by both groups. Every judges' ranks of the art pictures were then correlated with each of the other judges' ranks within their respective groups, and tabled in the form of a correlation matrix. An inspection of the matrix yielded two clusters within the art education judge group, and two clusters within the non-art judge group. The clusters were correlated with each other to determine whether or not independence of judged preference existed between them. With independence established in all comparisons, the next phase of the investigation was to determine the relationship of the personality characteristics to the different judge clusters. It was hypothesized that differences would exist between judge clusters, on the personality variables comprising the test battery.

#### The Data

In the group comparisons between art education and non-art judge personnel, significant differences were found on 4 of 6 personality variables, with probability levels less than .001 in three cases, and less than .02 in the other.

In the comparisons between art education and non-art judge clusters, significant differences were found on 4 of 6 personality variables. In both comparisons stated above, the art education judges had higher mean scores on all variables.

Within-group cluster comparisons showed the art education clusters significantly different on the authoritarian measure. The within-group clusters of non-art judges were significantly different on one temperament trait and on aesthetic judgment.

#### Major Conclusions

Based on the preceding investigation, the following conclusions are stated:

1. A direct relationship exists between the judgment of art works and several personality characteristics of graduate art education and graduate non-art judges.
2. Clustering occurs among graduate art education and non-art judge groups, in their judgments of art works.
3. A direct relationship exists between graduate art education judges who are similar in personality characteristics and the manner in which they cluster in their judged preferences for art works.
4. Clusters are independent of each other contingent upon differences in their judged preferences of the same art works.
5. Graduate art education judges agree less with each other in their judgments of art works, than do graduate non-art judges with each other, in their judgments of the same art works.
6. Graduate art education judges are biased at the abstract end of a continuum, whereas graduate

non-art judges are biased at the realistic end of a continuum, in their judged preferences for art pictures.

7. Graduate art education judges who scored higher on an authoritarian measure were also more rigid in their judgments as indicated by their preferences for abstract choices, in nine of ten cases.
8. On a measure of attitude toward the judgment of art works, graduate art education judges have a more favorable attitude to the function of judgment of art works than a comparable non-art judge group.

Microfilm \$2.75; Xerox \$9.45. 210 pages.

#### THE EFFECT OF FOOD DEPRIVATION IN BINOCULAR CONFLICT

(L. C. Card No. Mic 60-5576)

Martin Louis Maehr, Ph.D.

The University of Nebraska, 1960

Adviser: Warren R. Baller

#### The Problem

The primary purpose of this study was to determine whether or not food deprivation is systematically related to a preference for food related words or objects as opposed to non-food related stimuli in a binocular conflict situation. Proceeding from the theoretical formulations of Bruner and Postman it was predicted that under conditions when "motivational hypotheses" could be expected to be stronger than usual one could expect more than usual resolutions in favor of the need-related stimulus pattern.

#### Method and Procedure

It was necessary to design and construct an instrument by means of which conflicting stimulus patterns could be presented to similar retinal areas of the two eyes simultaneously. A Keystone Telebinocular was adapted for this purpose. Twenty four stereograms were prepared. A food related word or picture appeared on one side of each stereogram; a non-food related word or picture on the other. Each of the stereograms was reproduced and the left-eye-right-eye positions of the stimulus pairs were reversed so that it was possible to present each stimulus to each eye and thus randomize any possible influence of eye dominance.

Two experiments were conducted with the use of this apparatus. The first experiment involved testing 187 freshmen in the course of their participation in a routine physical examination at the Student Health Services clinic. The findings of this part of the total study being inconclusive it was necessary to arrange for a more highly controlled experimental situation in which to test the hypothesis. This more highly controlled observation is referred to as the "second experiment."

The second experiment involved 28 Reformatory inmates. The design for it was such that perceptual responses could be related to two conditions under which food orientation might be expected to vary. These were (1) deprivation vs. non-deprivation and (2) time of day

when the subject was used to eating vs. time of day when such was not the case. Assuming that "motivational hypotheses" would vary under both of these conditions it was predicted that perceptual resolution in favor of the need related stimulus would vary accordingly.

#### Results of the Study

The results of the first study, as already stated, did not indicate any systematic relationship between increase and/or decrease in food response and the time of day. A plausible explanation of the negative results would be that there was a lack of adequate visual and deprivation control in the first study. On the basis of this inference a further study was conducted.

In the present study (second experiment) satiated subjects tended to see fewer food related stimuli than deprived subjects but the differences were not statistically significant. The only plausible explanation for this -- tentative as it is -- would be that deprivation as employed in this study was not a strong enough reinforcer of expectancies ("motivational hypotheses") to produce the anticipated need related resolutions.

It was also predicted that subjects would see more food related stimuli on the occasion of the late-morning testing (at a time when it was assumed they would expect to eat) than at the time of the early-morning testing. This prediction was confirmed. The finding that a functional relationship exists between food related habits and binocular resolution gives support to Bruner and Postman's theoretical approach and suggests further that the methodology employed has some promise in the study of the influence of personality variables on perception.

Microfilm \$2.50; Xerox \$5.20. 103 pages.

#### AN EXPERIMENTAL INVESTIGATION INTO THE EFFECT OF FORMAT ON FOLLOWING WRITTEN DIRECTIONS

(L. C. Card No. Mic 60-5481)

Merle Byron Marks, Ed.D.  
University of Southern California, 1960

Chairman: Professor Finn

The purpose of this exploratory investigation was to find dimensions or critical characteristics of directions which will cause a greater number of students to follow directions on a test paper than would do so in response to conventional formats.

Twenty-two formats including the control were designed and subsequently tested in a junior high school. Chi-square, a "distribution free" statistic, was employed to determine the extent to which each dimension varied from the control. The extent of this variation from expectancy allowed results to be attributed to chance or to real differences between each dimension and the control.

The most promising of these dimensions were combined and tested in a second junior high school. The results of this two-phase testing program suggested answers to five major questions.

**Findings.** (1) Which dimensions of written directions are individually most promising? Key words in boldface type and primary size typewriter type both proved to be significantly more efficient than the control. Encircling with a parallelogram gave results near significance. (2) What are the effects of grade level differences within grades considered in this study? The older students followed directions to a greater extent than the younger ones. When ninth graders' results were compared with those of seventh graders, the differences were significant above the .001 level of confidence. (3) What are the effects of high or low reading ability? Above-average readers followed directions to a greater extent than average readers. Average readers surpassed below-average readers. Each difference was significant above the .001 level of confidence. (4) What are the effects of sex differences? Girls followed directions to a greater extent than boys did. This was tenable at the .01 level of confidence. (5) Does combining promising dimensions increase efficiency? When considering the very few combinations tested, the answer is in the negative. Treatment with a single effective dimension produced results as good as were obtained with the best combination of factors.

**Conclusions.** (1) It is possible to cause more people to follow directions by use of effective formats than would be expected with the use of conventional formats. (2) Special treatment of key words is a most important factor, but does not eliminate from consideration the usefulness of other factors. (3) Combining effective factors is probably no more efficient than the use of one of the most promising dimensions. (4) At the junior high level, it may be expected that older students will follow directions more often than younger ones. (5) The greater a student's reading ability, the more likely he is to follow directions. (6) Girls are more likely to follow directions than boys are.

**Recommendations.** (1) Focus attention on key words with boldface letters, underline, enlargement, or contrasting color. (2) Use primary size typewriter type if space permits. (3) Encircle directions with a parallelogram. (4) Use single space between typewritten lines. (5) Do not surround directions with a "busy" border. (6) Do not underline the entire statement. (7) Do not capitalize all words in the directions. (8) Do not consume needed space with prefatory phrases.

Psychological considerations concerning attitudes, peripheral pressures, physical aspects of the room, mental sets, goals, and individual motivation need to be explored. Further study of the following questions should be made: (1) What is the effectiveness of individual dimensions and combinations as they relate to various groups of heterogeneous and/or homogeneous people? (2) What is the temporal continuity of the effective dimensions? Will repetition negate effectiveness? (3) Does efficiency increase significantly when oral comments reinforce written directions? (4) How may interest through content be applied to increase efficiency of directions?

Further investigation of the efficiency of many selected combinations of dimensions should be made.

Microfilm \$2.50; Xerox \$5.80. 117 pages.



**SELF-JUDGMENTS AND OBJECTIVE MEASURES  
AS RELATED TO FIRST SEMESTER  
ACADEMIC ACHIEVEMENT OF  
NON-SELECTED COLLEGE STUDENTS**

(L. C. Card No. Mic 60-5451)

Glenn E. Mowers, Ed.D.  
The Pennsylvania State University, 1960

The purpose of the study was two-fold: (1) to appraise the value of the rank in the high school graduating class and/or a scholastic aptitude test score in the prediction of first-semester collegiate academic achievement at the University of Toledo; and, (2) to investigate the relationship of certain student self-judgments about high school achievement and scholastic aptitude to first-semester collegiate academic achievement.

The value of the rank in the high school graduating class and/or a scholastic aptitude test score in the prediction of first-semester collegiate academic achievement was studied through three population samples (359 women; 357 men, non-engineering; and 304 men, engineering). These students enrolled in four-year degree programs at the University of Toledo in September, 1955, and September, 1956, and data about both variables (decile rank in the high school graduating class and raw score on the Ohio State Psychological Exam, Form 24) as well as criterion data (first-semester collegiate academic average) were available for all students. An analysis of variance performed on the data for each population sample indicated that the decile rank in the high school graduating class and the test score were equally effective in the prediction of first-semester collegiate academic success (no significant difference was found between the effectiveness of one variable over the other) for each population sample. However, it was demonstrated that for each population sample the proper combination of both variables produced a significantly superior prediction of first-semester collegiate grade average over a prediction derived from either variable taken alone. Prediction formulae utilizing the two variables were developed from the 1955-56 population samples and were found to be valid predictors of probable first-semester collegiate academic achievement for respective population samples of freshmen who entered four-year degree programs at the University of Toledo in September, 1957.

Student self-judgments about high school achievement and scholastic aptitude were studied by stratifying the freshmen who enrolled in the University of Toledo four-year programs in September, 1957, into three population samples (124 women; 131 men, engineering; and 176 men, non-engineering). All students were asked to make two separate self-judgments about their decile rank in the high school graduating class, their decile rank on a scholastic aptitude test, and their anticipated first-semester grade average. All population samples possessed rather stable and realistic self-judgments with respect to decile rank in the high school graduating class but fluctuating and comparatively unstable and unrealistic self-judgments with respect to decile rank on the scholastic aptitude test. While pre-college self-judgments about each variable correlated positively with first-semester grade average, these correlations did not improve the effectiveness for predicting first-semester grades already established by developed prediction formulae using actual

decile rank in graduating class and actual decile rank on a scholastic aptitude test. These prediction formulae were as effective for students who made unrealistic self-judgments about their rank in the high school graduating class and decile rank on a scholastic aptitude test as for students who made realistic self-judgments about these same variables. There was a tendency, however, for students who ranked below the median on each variable to over-estimate their actual standing on respective variables, and for students who were above the median on the scholastic aptitude test to under-estimate their standing on the test; students who ranked in the upper half of their respective high school graduating class tended to make realistic self-judgments about this variable. Developed prediction formulae for all population samples were superior to student's self-judgments in predicting the most probable first-semester grade average.

Microfilm \$2.50; Xerox \$7.80. 168 pages.

**HIGH SCHOOL COUNSELOR AND TEACHER  
PREDICTION OF COLLEGE SUCCESS  
AS RELATED TO OBJECTIVE PREDICTOR  
MEASURES AND TO COUNSELOR AND  
TEACHER CHARACTERISTICS**

(L. C. Card No. Mic 60-5696)

James C. Ribbeck, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor Kenneth B. Hoyt

Problem

This study was designed to investigate two basic problems pertaining to clinical prediction of college success: (1) Are there characteristics which are peculiar to those secondary school teachers, counselors, and teacher-counselors who are most accurate in making predictions of college achievement? (2) Does the addition to actuarial data of clinical predictions of college achievement enhance the accuracy of actuarial prediction based upon high school grade point averages, high school ranks in class, and composite scores on the Iowa College Scholarship and Placement Exam? Several related problems were also investigated. It was anticipated that the findings of this study might be potentially useful in training of high school counselors and in college admissions procedures.

Procedures

A total of 347 teachers, counselors, and teacher-counselors from 52 Iowa high schools made clinical predictions of academic achievement in college for 563 of their students who had entered the State University of Iowa as freshmen in September, 1958. All teachers, counselors, and teacher-counselors completed the Minnesota Teacher Attitude Inventory and a questionnaire which elicited information concerning personal and educational backgrounds and experiences. In addition, counselors and teacher-counselors completed a standardized questionnaire entitled How I Counsel.

The following statistical procedures were used to

analyze the data concerning the basic problems attacked. Correlations were computed between characteristics associated with the members of the sample and the degree of accuracy with which those in the sample predicted college grade point average.

Each of the following plus actuarial data were the independent variables in four multiple regression problems: (1) mean clinical predictions derived from one or more predictions of college grade point average by members of the sample, (2) counselor predictions, (3) selected teacher predictions, and (4) counselor and selected teacher predictions. The dependent variables in these analyses were the college grade point averages obtained by students for whom predictions were made.

Each related problem was analyzed with appropriate statistical procedures.

#### Findings and Conclusions

1. No meaningful relationship exists between any of the investigated characteristics of teachers, counselors, and teacher-counselors taken as a group or of teachers taken alone and the accuracy with which the members of such groups make predictions of college grade point average.

2. There appears to be at least a limited relationship between number of counselor contacts with students and accuracy with which counselors are able to make predictions of college grade point average.

3. The additions to actuarial data of mean clinical predictions and also of selected teachers' predictions of college grade point average enhance the accuracy of actuarial prediction of college achievement.

4. The addition of counselor predictions of college grade point average has not been shown to improve the accuracy with which predictions of college achievement are made from selected actuarial data.

5. Each of the following groups is able to predict college achievement more accurately than chance: counselors, teacher-counselors, and seven subgroups of teachers divided according to major teaching area.

6. For practical purposes, it has not been shown that there is a difference between any of the following groups in terms of the degree of accuracy with which they make predictions of college grade point average: teachers considered as groups, counselors, teacher-counselors, and seven subgroups of teachers.

7. There is no evidence to support the hypothesis that there is a difference between teachers, counselors, and teacher-counselors in terms of the accuracy with which they make predictions of persistence in college.

8. There is a positive relationship between student scholarship in high school and predictions of college grade point average made by counselors, teacher-counselors and seven subgroups of teachers.

Microfilm \$5.20; Xerox \$18.45. 406 pages.

#### AN INVESTIGATION OF THE RELATIONSHIP BETWEEN PEER ACCEPTANCE, CHRONOLOGICAL AGE, INTELLIGENCE, AND ACADEMIC ACHIEVEMENT OF SEVENTH AND EIGHTH GRADERS.

(L. C. Card No. Mic 60-4930)

William Burke Royster, Ed.D.  
University of Maryland, 1959

Supervisor: Professor Richard M. Brandt

#### Purpose

The purposes of this study were:

- A. To investigate the relationship existing between peer acceptance, acceptance of peers, age, intelligence, and academic achievement as measured by standardized tests and teachers' grades.
- B. To determine if there is any difference in the relation between peer acceptance, acceptance of others, age, intelligence, and academic achievement due to sex or grade level placement, and also to determine if there is any difference in youngsters' ability to predict peer acceptance due to these factors.
- C. To determine if there is a relationship between acceptance of others and age, intelligence, and academic achievement.
- D. To determine what relationship exists between peer acceptance and the ability of boys and girls to predict their acceptance.
- E. To determine the value of Cunningham's Social Distance Scale for measuring peer acceptance.

#### Procedure

Five sections of a seventh grade class and five sections of an eighth grade class were used in this study. This represented 50 per cent of the seventh and eighth grade population of a junior high school in the metropolitan area of Washington, D. C. There were 314 students, including 85 boys and 98 girls from the seventh grade and 64 boys and 67 girls from the eighth grade.

Intelligence scores were determined by the Lorge-Thorndike Intelligence Test administered in October. Academic achievement in reading, spelling, language, and arithmetic was determined by the Stanford Achievement Test for the seventh graders and the California Achievement Test for the eighth graders. Teachers' grades given the first nine weeks of the year were used to determine achievement in core, math, and physical education.

Peer acceptance, acceptance of peers, and predicted peer acceptance were determined by Cunningham's Social Distance Scale and sociometric questionnaires administered in October. Follow-up data on peer acceptance and acceptance of peers were collected again in April using the same instruments with one section of the seventh graders and one section of the eighth graders.

Means and standard deviations were determined for peer acceptance, acceptance of peers, age, intelligence, and achievement. Correlation coefficients were calculated to determine the relationships existing between these factors. Differences between these correlations for boys



and girls and for seventh and eighth graders were determined by changing the correlations to Z scores and testing for significance.

### Findings

Peer acceptance was related significantly to intelligence and achievement as determined by standardized tests and teachers' grades for each grade level group. However, when boys and girls were considered as separate groups at each grade level, peer acceptance and achievement in spelling were not related significantly for seventh grade boys and girls. Achievement in spelling and physical education was not related significantly to peer acceptance for eighth grade boys. The relationship between peer acceptance and achievement in physical education for eighth grade boys was the only relationship that was significantly different for any group.

There were only two significant relationships between acceptance of peers and peer acceptance, age, intelligence, and achievement. Chronologically older seventh grade girls were less accepting of others and eighth grade boys who had high grades in math were less accepting of others.

Seventh and eighth grade girls in the high acceptance group, seventh grade boys, eighth grade boys and eighth grade girls in the low acceptance group had a significant relationship between peer acceptance and predicted peer acceptance.

Peer acceptance scores on Cunningham's Social Distance Scale were related significantly to peer acceptance scores on sociometric questionnaires.

Peer acceptance scores on Cunningham's Social Distance Scale in October were related significantly to peer acceptance scores on the same instrument six months later.

Microfilm \$2.50; Xerox \$5.20. 103 pages.

### A SURVEY OF GUIDANCE PROCEDURES IN CERTAIN NATIONALLY ACCREDITED GRADUATE PROGRAMS FOR GRADUATE NURSES

(L. C. Card No. Mic 60-4866)

Sarah Frances Mullins Russell, Ph.D.  
The University of North Carolina, 1960

Supervisor: William D. Perry

The purpose of this investigation was to make a study of the guidance procedures in seven nationally accredited graduate programs for graduate nurses in the West and in the South to learn what guidance procedures are being used, to make it possible to give this information to the faculties of these programs, and to provide material for others who might want to make further study of the problem.

A questionnaire to be used as a guide in interviewing respondents was constructed, pre-tested, and revised. A visit was made to the headquarters of the National League for Nursing in order to review materials on file and to have conferences with various personnel. Each graduate program for graduate nurses was visited so that the writer could have conferences or interviews with the graduate nurse students who enrolled for the first time in

September 1959 as full-time students in these graduate programs for graduate nurses, nurse faculty members, directors of the programs, and deans of the schools of nursing.

In general, the findings of this study indicated that guidance procedures and facilities established by the universities are used by the students in the graduate programs for graduate nurses. The graduate programs for graduate nurses do not seem to have organized guidance programs, committees called guidance committees, or professionally prepared counselors employed as such on their faculties. There are, however, committees concerned with guidance, and there are professionally prepared counselors available.

The administrators and faculty members of the graduate programs for graduate nurses answered that they usually direct the guidance of their students. The administrators indicated that there are adequate financial aid, facilities, and secretarial help for carrying out such guidance procedures as exist in most of these graduate programs for graduate nurses.

Whether or not students are assigned to specific faculty members for counseling, the students are apparently free to select whom they desire for counseling. Educational guidance seems to be the primary type of guidance given by the administrators and faculty members of the graduate programs for graduate nurses. Vocational and health guidance appear to be given more often than emotional and personal guidance. Assistance seems to be given with placement, but little, if any, follow-up is done of students after they leave the universities.

Answers of the participants lead to the conclusion that administrators and faculty members are better informed about guidance procedures and facilities available for students and more pleased with them than the students are. Collected data give evidence that there is some lack of communication between administrators and faculty, between administrators and students, and between faculty and students in these graduate programs for graduate nurses.

On the basis of the data collected for this study, it is recommended that:

1. Each area of guidance be studied to learn its requisites and activities with the goal of integrating it into the establishment of an organized guidance program.
2. Leadership responsibilities for guidance, in addition to educational guidance, be assumed by qualified faculty members.
3. In-service programs about guidance be developed for the faculty, so that all the administrators and faculty members in these graduate programs for graduate nurses may participate more actively in guidance.
4. A system for continuous evaluation of its guidance be established in each of these graduate programs for graduate nurses.
5. Follow-up services be developed more carefully to assist the former students in their adjustments to positions and to improve the guidance procedures for present students.
6. The philosophy of each school of nursing be studied with the view of determining how well its stated and implied objectives in relation to guidance are being met.
7. Similar studies be made of the guidance procedures in other nationally accredited programs for graduate nurses.

Microfilm \$3.25; Xerox \$11.25. 249 pages.

# A SURVEY OF BEGINNING GUIDANCE PROGRAMS IN CERTAIN IOWA HIGH SCHOOLS

(L. C. Card No. Mic 60-5699)

Krestian Norman Severinsen, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor Kenneth B. Hoyt

## PURPOSE

The purpose of this study was two-fold. One purpose was to evaluate the effectiveness of enrollees in the 1959 Counseling and Guidance Training Institute in establishing or expanding guidance facilities in their respective schools. The survey was designed to determine how effective the enrollees were in inaugurating or expanding facilities or whether such expanded facilities resulted in any differences in attitudes or self-concepts on the part of graduating seniors. The second purpose of the investigation was to determine the extent to which certain characteristics of these enrollees are related to changes within the schools during the first year following the institute.

## THE SAMPLE

Only enrollees who would have the major responsibility for the counseling of senior high school pupils in Iowa public secondary schools were included in the sample. Thirteen were included in a senior questionnaire survey; nineteen were included in the total sample. After attending the institute these enrollees had minimal qualifications to become endorsed as teacher-counselors in the state of Iowa.

## PROCEDURES

Information regarding the status of guidance facilities in 1958-59 and 1959-60 was collected by the investigator during two personal visits to the schools. This information was presented to three guidance specialists to be rated. Differences in mean judges' ratings for each school were computed for each facility. Guidance facilities investigated were: (1) counseling, (2) time scheduled, (3) physical facilities, (4) cumulative records, (5) testing program, (6) information service, (7) miscellaneous.

Twelve criteria of the effect of increased guidance services on seniors were investigated. The data for these criteria were collected from questionnaires administered to the 1959 seniors, who had little or no guidance, and 1960 seniors, who had the additional services of a teacher-counselor for one year. This data was compared with data taken from school records regarding class rank and IQ. The criteria investigated were: (1) percentage who liked school, (2) percentage aware counseling was available, (3) percentage who said they had counseling, (4) percentage who felt they benefited, (5) discrepancy in class rank estimate, (6) discrepancy in IQ estimate, (7) percentage with high ability, not college bound, (8) percentage with low ability, college bound, (9) percentage with no post high school plans, (10) percentage who consulted school officials about plans, (11) certainty of post high school plans, (12) adequacy of occupational information possessed.

## FINDINGS

After the enrollees were employed as teacher-counselors for one year: (1) there were significant improvements in the mean judges' ratings of the extent of each of the guidance facilities investigated for all schools combined; (2) there was a significant increase in the proportion of seniors who were aware of the availability of counseling in their schools, and a decrease in the mean of seniors' ratings of their certainty of post high school plans; (3) the remaining criteria revealed no significant differences.

An investigation of the relationships between enrollee characteristics and the various criteria indicated the following results: (1) improvements in certain guidance facilities were negatively related to the amount of enrollees' previous training and experience in guidance, indicating that where the enrollee had been engaged in guidance activities and had the most previous training, the school had less potential for improvement; (2) enrollees' institute grade point averages were positively related to improvement in certain guidance facilities; (3) enrollees' Miller Analogies scores were positively related to improvements in the information services and to the increase in the proportion of seniors who were aware of the availability of counseling in their schools.

Microfilm \$2.50; Xerox \$8.20. 179 pages.

# THE INTERRELATIONSHIPS OF INTERESTS AND ATTITUDES AND SPECIFIED INDEPENDENT VARIABLES IN THE TEACHING OF NATURAL SCIENCE BY TELEVISION IN THE FIFTH GRADE

(L. C. Card No. Mic 60-5585)

A. Cornelia Sheehan, Ed.D.  
Boston University School of Education, 1960

## PROBLEM:

To what degree and in what direction will interests and attitudes of the subjects toward science and scientists change as a function of experimental treatment and as a function of certain characteristics of the subject?

1. What is the effect upon (a) pupil interest in science, (b) pupil attitude toward scientists, (c) pupil leisure-time activities, (d) television viewing habits, of each of the following variables:
  - a. Training of teachers in both science and television workshops as compared to no special training provided
  - b. Use of television to initiate or to terminate a unit of study
  - c. Pupil participation through a common class assignment or through the development of interests and specialties by individual projects
  - c. The use by teachers of a study guide or independent direction in lesson planning.
2. What is the interrelationship of attitude type (positive, negative, uncertain) and the degree and direction



of attitude change, and what is the relationship of attitude change to subject's status with regard to perception of reality (image of scientists), adult values and stereotype of scientists, entrenchment in peer or adolescent value system, and consistency of beliefs and attitudes with regard to science and scientists.

#### POPULATION:

The experimental group consisted of 72 randomly chosen fifth grade classes in which 24 of the teachers had been trained in the utilization of television in the elementary school, 24 had been trained in science teaching for the elementary grades, and 24 had received no special training. One half of the classes used the televised programs to initiate learning and the other half used the programs to terminate or conclude learning on a particular topic. Half of the teachers were supplied with study guides for the programs, the other half directed the learning independently. A common class assignment for each unit was given to the pupils in half of the classes while in the other half of the classes they worked on individual projects in conjunction with the programs.

The control group consisted of 18 randomly chosen classes which viewed the natural science programs each week but did not experience any of the other experimental conditions.

#### MATERIALS:

The experimental materials consisted of a series of 30 half-hour natural science programs produced by the Massachusetts Audubon Society and designed to develop understanding of the intricate relationships of all living things to their environments. These programs telecast by WGBH-TV were viewed in all classes (90) in the study beginning in early October, 1959, through to June, 1960.

#### PROCEDURE:

The following instruments were constructed and administered as pre-tests in October and as post-tests in May to measure change in the dependent variables:

1. Interest Inventory
2. Attitude Scale: Part I-Values  
II-Beliefs
3. Leisure Activities Check List
4. Television-viewing Check List

#### RESULTS:

The main statistical technique for examining the data for significance was analysis of variance. The following major results were observed:

1. Interest: The over-all effect was a decrease in interest in science, a loss in the experimental group, a negligible gain in the control group, no change for boys, a loss for girls, and a loss associated with the top I. Q. quarters. Four-way analysis by experimental category revealed significant effects by teacher training, initiating-terminating use of television and type of assignment in interaction.

2. Attitude Scales: Gains in realism of perception of scientists appear to be associated with

- a) being unlike adults in perception of scientists
- b) being originally somewhat realistic
- c) being high in similarity to positive adolescent image of scientists
- d) being low in similarity to negative adolescent image of scientists
- e) having high uncertainty with regard to perception of scientists to begin with.

Increased negative attitude toward science and scientists appears to be a function of

- a) being like adults in perception of scientists
- b) being like adults in values
- c) having high adolescent positive score
- d) having low adolescent negative score
- e) having low uncertainty score
- f) having high stable peer values score.

3. Leisure Activities: No difference between control and experimental groups; for girls in the experimental group, teacher training and type of assignment in interaction had an effect on gain. There was, however, a tendency for science-related activities to decrease in general.

4. Television viewing was found to be significantly correlated to interest—high science interest resulting presumably in the election to view more science-related television programs.

#### CONCLUSIONS:

The general effect seems to have been one of depressing science interest by the emphasis placed on it by the research project and by those teachers who received special training by participation in workshops. The loss does appear to be differentially associated with sex and I. Q., and the depressing effect did not occur in the control classes which merely viewed the programs but did not have to do assignments in that connection. A closer examination of change by individuals in their perception of and attitudes toward science and scientists suggests that factors other than the experimental assignments made to the groups were operating in the experiment, e.g. similarity to values of peers and adults, degree of initial uncertainty, degree of original realism and positiveness or negativeness of attitude, to produce change.

Microfilm \$2.55; Xerox \$8.80. 193 pages.

# STRUCTURE OF THE PSYCHOLOGICAL REFERRAL PROCESS

(L. C. Card No. Mic 60-4950)

Robert Sherman, Ed.D.  
Rutgers University, 1960

**Problem.** The purpose of the investigation was to examine the structure of the psychological referral process in order to determine the manner in which psychological referrals were made, handled, and reported; and the procedures through which assistance was given in selected New Jersey public school systems.

Twelve systems with enrollments of 1,250-10,000 pupils were selected within the New Jersey counties of the greater New York metropolitan region. Only those employing one or more full-time psychologists, having had a psychologist on the staff for at least three years, and consisting of grades kindergarten through high school were included.

**Procedures.** The investigation was a descriptive study of a process, and the methods reported in the literature pertaining to such a study were used. Data were gathered by use of the Inventory of Psychological Referral Services constructed specifically for the investigation and filled in during an interview with the psychologists. Copies of all written policies and forms used in the process were collected at the same time. Data were analyzed in terms of practices recommended in the literature, pupil-to-psychologist ratios, other personnel specialists employed, and size of pupil and community populations.

**Findings and conclusions.** The following findings and conclusions pertaining to the selected school systems were derived from practices recommended in the literature and reported practices in the selected school systems:

1. There was general agreement with respect to most referral practices.
2. The typical pattern of referral was the completion of a standard referral blank by the teacher, approval by the principal, and submission to the psychologist. In secondary schools, the counselor received the initial referral from the teacher.
3. Most of the cases referred concerned evaluation for special class placement, academic difficulties, or social and emotional problems.
4. Reported pupil-to-psychologist ratios of 1,400-8,300:1 compared with a ratio of 800-1,000:1 as recommended in the literature.
5. Roles of the psychologists and others involved in the referral process in a majority of systems were established more by custom than by any stated policy, resulting in some ambiguity in patterns of communication and functioning.
6. A trend was observed toward a multi-disciplinary approach to referral problems. Social workers, speech and reading specialists, counselors, and psychologists were being employed in each system.
7. The child received little direct help from the psychologist who functioned in most of the selected systems as a diagnostician and staff consultant, making recommendations to others to assist the child.
8. Omission in most selected schools of planned in-service training, follow-up, evaluation, and research

procedures constituted major weaknesses in the referral process.

**Recommendations.** The following recommendations are applicable to the selected school systems and others with similar characteristics:

1. Excessive pupil-to-psychologist ratios should be reduced, and needed facilities and clerical assistance should be provided by utilizing subsidies available under the New Jersey 1959 bill for the socially and emotionally disturbed child and the National Defense Education Act.
2. A coordinator should be appointed to assume over-all responsibility for the referral process.
3. Where the school psychologist functions as a diagnostician and consultant in referral cases, other trained staff members or community resources should be available to render the type of assistance recommended for the child.
4. Planned follow-up, evaluation, and research programs should be introduced wherever lacking, and case records should be examined to determine the effectiveness of the results of referral.

**Other research needed.** Other studies should be made:

1. To examine teacher, principal, and counselor skills in identifying referral cases and in implementing recommendations made by psychologists.
2. To identify the objectives of special services programs and the expectations of school personnel concerning special services.
3. To determine whether therapy is a legitimate function of the school psychologist.

Microfilm \$2.50; Xerox \$8.40. 185 pages.

## SITUATIONAL ACTION TESTS AS A MEASURE OF THE EFFECTIVENESS OF PUBLIC SCHOOL PRINCIPALS

(L. C. Card No. Mic 60-4587)

John Arthur Silvester, Ed.D.  
Utah State University, 1960

Major Professor: Dr. W. R. Borg

### Purpose of Study.

The recognized need for educational leaders and the lack of reliability and validity of the many methods of leader selection makes it evident that one of the important problems in education is the development of adequate selection procedures of school administrators. The various methods commonly used may have their values, but also have many weaknesses.

The critical factors of administration, generally neglected by even the best of the commonly used measures, center around human relations skills. These skills are only displayed in action situations, and, therefore, can only be observed and rated in action situations.

The general objectives of this pilot study were to develop and validate a situational action test battery for the selection of school principals and to discover, if possible, areas that held promise for a more extensive study.



### Hypotheses.

The following hypotheses were tested:

1. There are certain critical characteristics that are generally recognized to be important to the success of school administrators.
2. Some of the critical characteristics of school administrators' success are measurable through the use of situational action tests.
3. Situational action tests administered to a sample of public school principals will produce results related to such criteria of administrator success as evaluation of these principals made by teachers, school superintendents, trained observers, and the principals' self appraisal.

### Summary of Procedures.

In order to determine the critical characteristics considered important for successful administration, the opinions of superintendents, board members, teachers, and other educators were gathered. Over 100 different characteristics, each mentioned from 1 to 35 times, were compiled into nine general categories. Six action situations were structured so these characteristics could be displayed and evaluated. Each of these face-to-face discussion situations presented a different type of human relations problem, with actors playing the other roles involved. Two trained raters independently evaluated the performance of each of the 28 school principals as he attempted to solve the problem.

Both the criteria rating scales and the situational rating scales were based on the same general areas. Subarea scores and total scores were used in the Rho correlations.

### Summary and Findings.

Reliability of each of the criteria was calculated, and 85 per cent of these Rho's were significant at the .05 level or better. Intercriteria reliability was also found, and 58 per cent of these correlations were significant at the .05 level or better. Interrater reliability of the various subareas and total scores of the six situational tests were computed and presented in table form (87 per cent of these correlations were found significant at the .05 level or better).

Correlations were found between the total scores of each situation and the total scores of the various criteria. Practically all of these were chance correlations as were the correlations between the situational subarea scores and corresponding scores of the criteria. The only subarea that revealed significant predictive value was the area of Communicative Skills.

### Conclusion.

It was concluded that: (a) there are certain critical characteristics generally recognized to be important to the success of school administrators; (b) some of these critical characteristics are measurable through the use of situational action tests; (c) the battery of action situations used in this study did not consistently and significantly predict the criteria used. However, this study suggests that the criteria measures used were unreliable. It also suggests that if the action situation is representative of the sort of work to be done, the judges qualified and well trained, their judgments well defined, and the

procedures for observing and evaluating are such that the situation can be consistently evaluated, then the results will have significant predictive value.

Microfilm \$2.60; Xerox \$9.00. 200 pages.

### PERCEPTUAL READINESS AND BEGINNING READING

(L. C. Card No. Mic 60-4214)

Dorothy Margaret Simpson, Ph.D.  
Purdue University, 1960

Major Professor: N. C. Kephart

This study was the result of an attempted differential diagnosis of the readiness problems of first grade pupils who were having reading difficulty. Examination of sub-test performances on the METROPOLITAN READINESS TEST seemed, on the basis of observation alone, to indicate that the sub-test (copying) was more predictive of reading performance than were those designated as "reading readiness" sub-tests.

Further indications of the relative correlations between perceptual abilities and reading achievement were obtained when the Biserual  $r$  formula was used to compute the correlations between METROPOLITAN READINESS TEST sub-test performances and reading achievement.

Subsequently, the study described in this thesis was undertaken. Its purpose was two-fold: 1. to determine the relative contribution of perceptual ability (as measured by the METROPOLITAN READINESS TEST and the PRIMARY MENTAL ABILITIES TEST) to first grade reading achievement, and 2. to assess the effectiveness of certain perceptual training activities in improving reading instruction.

Part 1. Three hundred twelve first grade pupils' sub-test scores and total scores on the METROPOLITAN READINESS TEST and PRIMARY MENTAL ABILITIES TEST were correlated with total scores earned on the METROPOLITAN READING TEST.

Part 2. The twenty-four pupils in the experimental instruction group were provided activities designed to increase perceptual skills. The twenty-four pupils in the control group did not receive perceptual training.

The coefficients obtained (by the Pearson  $r$  formula) in correlating sub-test performances on the METROPOLITAN READINESS TEST and PRIMARY MENTAL ABILITIES TEST with METROPOLITAN READING TEST results showed that the perceptual sub-tests (numbers, matching, copying, quantitative, and space) correlated relatively more highly with reading achievement than did traditionally designated "reading readiness" sub-tests such as "sentence meaning" and "information."

The comparison of the reading achievement of the perceptual training group and that of the control group revealed that the 3.33 months' greater average reading achievement of the perceptual training group was statistically significant at between the two per cent and five per cent levels.

An extension of such investigations may well reveal important possibilities for increasing children's chances for success in reading.

Microfilm \$2.50; Xerox \$5.20. 103 pages.

**A STUDY OF RELATIONSHIPS BETWEEN  
CERTAIN PERSONAL AND SOCIO-ECONOMIC  
FACTORS AND UNDERACHIEVEMENT**

(L. C. Card No. Mic 60-4706)

John Louis Snellgrove, Ed.D.  
University of Alabama, 1960

The primary purpose of this study was to determine what relationships, if any, exist between personal and socio-economic factors and underachievement of high school students at both junior and senior high school levels.

Eight major hypotheses were set up to reflect the purpose of this study. The actual testing of the hypotheses was accomplished by administration of three instruments to a selected group of underachievers: (1) California Test of Personality; (2) Fields-of-Study Motivation Record; and (3) a questionnaire.

Subjects for the study were selected by determining scores on the Primary Mental Abilities Test and, through statistical procedures, comparing these scores to grade point averages on major subjects. After comparing the records of approximately 2300 students, a final selection of 213 pupils was made. A student was classified as an underachiever when there was a 1.25 standard deviations difference between grade point average in major subjects and PMA scores, the latter being the higher of the two variables. Of the original 213 pupils selected, only 196 were present on the day of testing.

The hypotheses stated in this study and conclusions drawn from them are stated below:

**Hypothesis I:** There are more males who are underachievers than there are females.

The above stated hypothesis is accepted at the .01 level of confidence, which indicates that there is a larger number of males who are underachievers than females.

a. When grades 7-12 were separated into two different grade levels (7-9 and 10-12), it was found that there was a slightly higher percentage of females than males at level 7-9.

b. It was also found that there was a higher number of underachievers at the 7-9 level than at the 10-12 level.

**Hypothesis II:** Underachievers motivated in certain academic subjects have higher grades in those subjects.

A positive biserial correlation was found to exist between grades and scores on the motivation test, areas of the test consisting of questions to measure motivation in: Art, English, Foreign Language, mathematics, science, physical education, vocational education, music, history and social studies.

**Hypothesis III:** Underachievers have personality disorders which are characteristic of this group of individuals.

The underachievers scored below the CTP test norms on Personal, Social, and Total Adjustment, the difference between medians being significant for males

and females combined or separated at the .01 level of confidence.

**Hypothesis IV:** Personality disorders which are prevalent in underachievers, if there are such disorders, gradually become increased from the seventh through the twelfth grades.

The reverse of the above was found to be true, i.e., personality maladjustments actually decreased in underachievers, as a group, from the seventh through the twelfth grades.

**Hypothesis V:** Individuals who plan college careers in school will be less likely to underachieve than those who do not set up this goal.

There was no significant difference between responses of underachievers and those of a control group on the questionnaire, except for combined 7-9 and 10-12 females, a lower percentage of females in the underachiever group planning on attending college.

**Hypothesis VI:** Underachievers rationalize the reasons for and often do not know such reasons for their underachievement.

There was no significant differences between males and females of the control and underachiever groups stating "studying" as a reason for underachievement. This was true for males and females separately or combined at any grade level or when grade levels were combined.

**Hypothesis VII:** Underachievers identify more with other underachievers than they do with individuals outside this group.

This hypothesis predicted that underachievers would name other underachievers as answers to statements on the questionnaire more often than pupils in the control group. No significant differences were found.

**Hypothesis VIII:** An individual who sets up an occupational goal earlier in school will be less likely to underachieve than one who does not set up this goal.

No significant differences were found between underachievers and the control group.

Microfilm \$2.50; Xerox \$8.80. 191 pages.



# RELATIONSHIP BETWEEN SELF-ESTIMATES OF OCCUPATIONAL COMPETENCE AND n-ACHIEVEMENT OF HIGH SCHOOL STUDENTS

(L. C. Card No. Mic 60-5580)

Hans Hermann Julius Steffen, Ph.D.  
The University of Nebraska, 1960

Adviser: Charles O. Neidt

## Purpose of the Study

The major purpose of this study was to determine the relationship between self-estimates of occupational competence and achievement motivation (n-Achievement) in groups of ninth and twelfth grade students. Concurrently, the relationship between General Aptitude Test Battery (GATB) scores and n-Achievement, and between GATB scores and self-estimates of occupational competence were investigated.

## Method of Procedure

The subjects for this investigation were 179 ninth graders and 166 twelfth graders from Nebraska City and Schuyler, Nebraska. Data for each subject included scores on McClelland's measure of n-Achievement, scores on the nine aptitudes of the GATB, and estimates of occupational competence on a List of Occupations, the latter of which yielded four modes of responses, namely overestimates, underestimates, correct appraisals of occupational competence, and correct appraisals of occupational incompetence.

## Results of Preliminary Analyses

No significant differences were found between subgroups with respect to n-Achievement scores when the subjects were classified by grade and sex, and by grade.

Comparison of subgroup means and standard deviations on GATB scores yielded no consistent pattern of differences. The classification of subjects by grade and sex, and by grade was therefore retained for further analyses.

Means and standard deviations were computed for the four modes of responses to the List of Occupations. Significant differences were found between twelfth grade girls from the two schools in both their overestimates and underestimates; between twelfth grade boys and twelfth grade girls from Nebraska City in their underestimates; and between ninth grade boys and ninth grade girls in their correct appraisals of occupational competence.

## Results of Major Analyses

The relationships between GATB scores and n-Achievement were expressed as coefficients of correlation in groups as classified by grade and sex, and by grade. Whereas none of them differed significantly from each other in contrasted groups, the coefficients of correlation for the ninth graders tended to be greater than those for twelfth graders.

Correlations between GATB scores and responses to the List of Occupations proved to be significantly different from zero in almost all instances. Overestimates and correct appraisals of occupational competence correlated

negatively with GATB scores, whereas underestimates and correct appraisals of occupational incompetence correlated positively with GATB scores.

The central issue of this investigation, the relationship between achievement motivation and self-estimates of occupational competence was investigated by computing correlation coefficients between n-Achievement scores and scores on four modes of responses to the List of Occupations. In general, relationships in the ninth grade showed greater consistency than in the twelfth grade. The tendency to overestimate occupational competence and the tendency to appraise occupational incompetence correctly were negatively correlated with n-Achievement, and the tendency to underestimate occupational competence and the tendency to appraise occupational competence correctly were positively correlated with n-Achievement.

## Conclusions

The relationship between self-estimates of occupational competence and n-Achievement were discussed in terms of a theoretical model of the relationship between achievement motivation and level-of-aspiration behavior as proposed by Atkinson. Relationships in the ninth grade were demonstrated to be in agreement with the theoretical model. Whereas the relationships in the twelfth grade did not substantiate Atkinson's hypotheses as readily as did the relationship in the ninth grade, they could nevertheless be explained in terms of Atkinson's theoretical concepts. Microfilm \$2.50; Xerox \$6.80. 143 pages.

# SELECTED CRITERIA FOR USE IN HIGH SCHOOL CUMULATIVE RECORDS

(L. C. Card No. Mic 60-4955)

Charles John Tabler, Ed.D.  
Rutgers University, 1960

**Problem.** It was within the design of this study (1) to present criteria to serve as a basis for a new cumulative record form in Jamesburg, New Jersey, High School, and (2) to present criteria for use by other high schools.

**Importance.** The primary value of the findings of the study was to aid Jamesburg in the revision of its cumulative record system. It also provided aid to other school systems considering similar action.

**Procedures.** Normative-survey research. The list of broad categories recommended by the National Committee on Cumulative Records in 1944 was used as the basic criterial reference.

The literature was examined to reveal concepts and principles regarding cumulative records. Pertinent data were obtained by means of an item analysis made of the cumulative record forms of nineteen New Jersey high schools.

**Findings and conclusions.** The majority of the selected New Jersey high schools used folders as the basic format for their cumulative records.

The broad categories recommended by the 1944 National

Committee on Cumulative Records were still acceptable in the light of later sources from the literature.

The recommended design of cumulative records indicated adequate provision was made for recording basic pupil needs.

The health record was considered an essential category of the cumulative record according to the literature. Similar consideration was not given to the health record in school forms examined.

The anecdotal record was considered an essential category in the literature. School forms examined did not include this category.

The inclusion of an item for extra-curricular activities was considered essential in both theory and practice.

The majority of high school forms studied indicated a preference for the folder-type of format.

**Recommendations.** Seven broad categories with appropriate items were recommended for use by Jamesburg High School in its cumulative record form: (1) Personal; (2) home and community; (3) scholarship; (4) test scores and ratings; (5) health; (6) school attendance; and (7) anecdotal records.

It was further recommended that Jamesburg High School utilize a committee to revise its cumulative record and that this committee should consider the philosophy of the school and its needs.

Other criteria recommended included the concepts derived from the study that should be considered as a rationale within which to function.

It was also recommended that the categories and items be organized on a form in a manner that would reflect the school's objective to meet pupil needs.

Microfilm \$2.50; Xerox \$8.20. 179 pages.

#### THE LEARNING OF SIGNED NUMBERS IN GRADES SEVEN, EIGHT, AND NINE.

(L. C. Card No. Mic 60-5468)

Robert J. Zelechowski, Ed.D.  
The Pennsylvania State University, 1960

#### PROBLEM

The purpose of this study was to learn the effects of mental age, algebra aptitude, and grade level on the learning of concepts and fundamental skills in handling signed numbers. Signed numbers were divorced from algebra for this study.

#### PROCEDURE

A total of 233 junior high school students, 76 ninth graders, 72 eighth graders, and 85 seventh graders, took part in the experiment. The mean chronological ages were 172 months for ninth graders, 162 months for eighth graders, and 150 months for seventh graders. Their mean mental ages were 167 months for ninth graders, 164 months for eighth graders, and 155 months for seventh graders.

One instructor presented twenty-five lessons to eight different class groups. The entire junior high school

student body except the slow learners, generally referred to as the special education class, participated in the experiment. The lessons contained the standard exercises relating to signed numbers which included the following topics: thermometer, loss-gain, east-west, owes-paid, latitude, saving-spending, north-south, stock market, B.C. and A.D., altitude, above-below, number scale, and the Active Surplus Method. The fundamental skills in handling signed numbers included addition, subtraction, multiplication, and division. Work with parentheses and the law of order of operation was included to give more meaning to the fundamental skills.

All class groups were taught the same twenty-five lessons. The instructor used 25 lesson cards; on each card the lesson plan for the day was written. No type of book was used, but fifteen lessons had homework assignments.

The criterion was a gain score which was the difference between a pre-test score and a post-test score. The prepared test of thirty-seven items had a reliability of .81 when used as the pre-test, and a reliability of .98 when used as the post-test.

Product moment zero-order, triserial, partial, and multiple correlations were used, and to help clarify the findings, means and standard deviations of the different groups were computed and compared. Correlations and t-tests were used to analyze the findings.

#### FINDINGS

The criterion, gain score, correlates best with mental age (.52), next with algebra aptitude (.45), and poorest with grade level (.28). The multiple correlation of the criterion with mental age, algebra aptitude, and grade level was .56. The correlations are significant at the 1% level of confidence.

The mean gain score for ninth graders was 32.70 with a standard deviation of 10.20; for eighth graders the mean gain score was 29.43 with a standard deviation of 11.31; and for seventh graders the mean was 25.93 with a standard deviation of 11.05. Dividing the same student body into three mental age groups, the mean for the high mental age group was 36.51 with a standard deviation of 9.69; for the middle group the mean was 29.49 with a standard deviation of 8.71; and for the low group the mean was 21.63 with a standard deviation of 10.02. Therefore, the high mental age group had a higher mean score and a smaller standard deviation than the ninth grade group.

According to this study, it can be stated that mental age is the strongest factor influencing the learning of signed numbers. Each of the grades did learn as indicated by computed t-values. Teachers should consider presenting selected concepts and skills relating to signed numbers to students in grades seven, eight, and nine. The selecting of the concepts and skills should be influenced by the mental ages of the students.

Microfilm \$2.50; Xerox \$5.80. 120 pages.



## EDUCATION, TEACHER TRAINING

ASPECTS OF AMERICAN COLLEGE TEACHING  
WHICH HAVE IMPLICATION TO  
HIGHER EDUCATION IN IRAN

(L. C. Card No. Mic 60-5591)

Torab Bassiri, Ph.D.  
University of Minnesota, 1960

Adviser: Professor George H. McCune

**Purpose** The purpose of this thesis is to investigate some aspects of American college teaching which can contribute to effective college teaching in Iran. The writer, out of his experience, realized that the philosophy and system of education and the methods of teaching in his country were not quite in line with national needs and modern practices in education. While investigating the causes of teaching ineffectiveness, he discovered that teaching is related to the total educational system of any country and the educational system, in turn, is closely related to economic, social, religious, political and historical factors. To explain these factors, the geographical location of Iran, her governmental system and some social and political problems which have influenced education are described in the first chapter. Chapter two, describes significant historical events which had influenced education and teaching. Chapter three deals with the educational system in Iran and its characteristics. Islam and its influence on education is the topic of the fourth chapter.

From what is discussed in these five chapters it can be concluded that teaching ineffectiveness is due to the following factors: 1) the centralized system, 2) an exclusively subject-centered curriculum, 3) excessive lecturing and memorization and, 4) lack of effective teachers. In finding some solutions, in Chapter five, the writer discusses definition of teaching, the criteria for effective teachers and some methods of teaching in the United States. Chapter six deals with learning, its relation to teaching, and its application to education in Iran. Chapter seven explains how informal relationship between the instructor and the students can improve teaching in Iran. The proper use of audio-visual materials in teaching is explained in Chapter eight. The last chapter of the thesis is devoted to the summary and recommendations.

**Methods and Procedure** The method followed is descriptive and historical. It is based on observation, collection, interpretation and application of findings.

**Conclusions and Recommendations** Some of the recommendations stated in the last chapter are as follows: If Iran wants to follow the step of democratic countries she should adopt a new philosophy of education, a philosophy which places more emphasis on students, their needs and their interests and at the same time fits into the total needs and cultural life of its people.

Through decentralization teachers should be given more freedom of action. Their standard of living and their social status should be raised. As part of the in-service education of teachers, professional organizations, summer workshops and educational conferences should be organized; college teachers should be encouraged to go abroad to study new ideas in education. Periodicals for the dissemination of educational ideas should be published.

Teacher training colleges should be established in every province. Research laboratories and well equipped libraries should be built. Audio-visual materials should be introduced in college teaching. The relationship of students and instructors must be improved. The method of teaching should be changed so that more attention be paid to students' individual differences and their needs. The improvement in education and teaching should help students to be prepared to meet the national needs in a modern and changing world.

Microfilm \$4.00; Xerox \$14.20. 312 pages.

COLLEGIATE MEASURES RELATED TO  
TEACHER EFFECTIVENESS

(L. C. Card No. Mic 60-5417)

Frederick Allen Brown, Ed.D.  
The Pennsylvania State University, 1960

This study was to determine whether or not measurable relationships exist for precollegiate and collegiate measures of elementary education graduates of the Lock Haven State College that can be related to the gain in achievement of the pupils they teach.

Academic gain as measured by the 1957 Edition of the California Achievement Tests for 1012 pupils in 41 classes taught by elementary education graduates of the college was used to determine the criterion measures. These criteria are used as the raw yearly gain criterion and also adjusted for mental maturity of the pupil by the use of the California Achievement Calculator to become the raw achievement calculator gain criterion.

The graduates used in the study were compared scholastically with a random sample of Lock Haven State College graduates who were of like sex and graduating class. This comparison was on the basis of total grade point average for college. The group used in the study was not found to be significantly different from the random sample with respect to mean grade point average or the standard deviation of the grade averages.

The elimination of the effect of variables found in schools, pupils, and differences in teachers gained after graduation was made in two ways. The teachers were selected where possible, with previous teaching experience in the same school and grade, free of principal or head-teacher duties, with no student teachers or other adults who instructed the subjects tested, and with children who did not have half day sessions in their educational backgrounds. Fifteen teachers did not meet one of these conditions, and five did not meet two of these conditions.

For each classroom, pupil intelligence, parents' education, tuition costs, teaching experience, number of children, amount of supervisory help available, credits earned beyond the bachelor of science degree, and years of non-promotion represented in the class were studied in relation to the raw criterion measures using correlation techniques. Three variables; tuition costs, parents' education, and credits earned by the teacher after the bachelor of science degree; were found to be significantly related to the gain. The residuals of the criterion measures after the effects of these three variables were eliminated using a regression formula were termed the adjusted yearly gain criterion and the adjusted achievement calculator

criterion. These adjusted criteria were used to test the hypotheses.

No relationship was hypothesized between the pupil gain and graduate's high school academic average; A. C. E. Psychological Examination for College Freshman test score; grade point averages for the first four semesters of college, major methods of teaching courses, student teaching and professional practicum, and other professional education courses; the supervisors' statements of strengths in student teaching; and the supervisors' statements of weaknesses in student teaching. Pupil gain was found to have a negative relationship with the high school academic average that was significant at the five percent level. Pupil gain was found to have a positive relationship with the grade point average for the first four semesters of college that was significant at the one percent level. Pupil gain was found to have a positive relationship with the grade point average for student teaching and professional practicum that was significant at the five percent level. Significant relationships between pupil gain and the other precollegiate and collegiate measures were not found. Hypotheses were rejected on the basis of the elimination of the influence of other precollegiate and collegiate measures by partial coefficients of correlation.

In this study pupils taught by Lock Haven State College graduates in elementary education were found to excel in academic achievement when compared with the expected performance of pupils with similar ability as indicated by national test norms.

Microfilm \$2.50; Xerox \$6.20. 126 pages.

A CO-ORDINATED PLAN OF ORGANIZATION  
AND ADMINISTRATION OF CERTAIN PHASES  
OF TEACHER EDUCATION FOR ALL  
DEPARTMENTS OF VIRGINIA STATE COLLEGE  
CONCERNED WITH THE PREPARATION  
OF TEACHERS

(L. C. Card No. Mic 60-5423)

Elsie Curl Colson, Ed.D.

The Pennsylvania State University, 1960

Statement of the problem. It was the purpose of this study to formulate a co-ordinated plan of organization and administration of the following nine phases of teacher education for all departments of Virginia State College concerned with the preparation of teachers: orientation to the teaching profession, common core of experiences for prospective teachers beyond those required for orientation, a testing program, guidance for prospective teachers, semester-hour requirements prerequisite to student teaching, eligibility requirements for student teaching, philosophy of education and the learning process, assignment to student teaching, and supervision of student teachers.

Procedure used in the study. The procedure used in the study involved the following major steps: studying special committee reports and recommendations with regard to prevailing teacher-education practices at Virginia State College; reviewing related literature for the period, 1925-1959, from which was secured information on trends with respect to co-ordination in teacher

education; deriving statements of principle from the Standards and Guide for Accreditation of Teacher Education of the National Council for Accreditation of Teacher Education; searching for related doctoral studies; constructing and using a questionnaire in securing, from land-grant colleges and universities in the United States and Puerto Rico, information on co-ordinated features of their teacher-education programs; and using the principles and value judgments from the literature and the implications of the questionnaire data as a frame of reference for the program proposed for Virginia State College.

Results and Conclusions. The review of the literature revealed a highly favorable attitude toward campus-wide unified programs of teacher education. The questionnaire data revealed varying degrees of co-ordination among the forty-three cooperating colleges and universities in their organization and administration of the nine features of teacher education to which the study is confined. With few exceptions, however, the largest single group response to each questionnaire item was that of the colleges and universities that do co-ordinate the feature of teacher education referred to in a particular item. The major exceptions to co-ordinated practices were in the areas of "testing," and "semester-hour requirements in major and professional courses prerequisite to student teaching."

The following co-ordinated plan of teacher education was proposed for Virginia State College:

1. An over-all plan of organization involving a Director, a Faculty Co-ordinating Council, and the following sub-committees: a Guidance Committee, a Curriculum Committee, and a Student Teaching Committee.
2. A Director of the Council, the Director of the School of Education, to serve as chairman of the Council and to co-ordinate the proposed program.
3. The Faculty Co-ordinating Council composed of heads of departments in the School of Education, the directors or designated representatives of other colleges and/or divisions in which departments are concerned with the preparation of teachers, and the chairmen of the three sub-committees; the Council to determine objectives and policies of the over-all program and of its constituent parts.
4. Each of the three sub-committees, headed by a chairman or co-ordinator appointed by the Director from among the faculty of the school of Education, to be composed of representatives from the various departments in proportion to the number of their enrollees in the teacher-education program.
  - a. The Guidance Committee to assume responsibility for the guidance of all prospective teachers regardless of their areas of specialization or the levels at which they plan to teach.
  - b. The Curriculum Committee, in conjunction with the Student Teaching Committee, to determine orientation-to-teaching experiences, common-core professional experiences, semester-hour requirements prerequisite to student teaching, philosophy of education, and the learning process.
  - c. The Student Teaching Committee, in conjunction with the Curriculum Committee, to determine pre-student teaching requirements; to make all



assignments for student teaching; and to arrange for and conduct the supervision of student teachers as it relates to college supervision and to supervision on the part of cooperating public school personnel.

Microfilm \$2.70; Xerox \$9.45. 207 pages.

A STUDY OF CERTAIN CHARACTERISTICS  
OF THE STUDENT BODY IN  
THE COLLEGE OF EDUCATION AT  
THE UNIVERSITY OF ALABAMA, 1955-59.

(L. C. Card No. Mic 60-4700)

James Frank Cummings, Ed.D.  
University of Alabama, 1960

The study was undertaken in an effort to consolidate some of the available information concerning students in the College of Education at the University of Alabama and to compare students in certain selected subgroups in an effort to determine in some measure the extent to which generalizations concerning the student body could be made.

Five variables were identified which represented areas in which differences might be found between and among the group of prospective teachers in the College. These variables were: (1) place of residence, (2) sex, (3) selection of subject-matter major; (4) attrition and retention, and (5) curriculum or institution in which first enrolled. The purpose of this study was to identify differences, if any, in the characteristics of students in subgroups related to these five variables, and the extent to which such differences, if found, were statistically significant.

The five major questions raised for study were:

- (1) What differences, if any, exist between students from Alabama and students from out of state in the College of Education?
- (2) What differences, if any, exist between male students and female students in the College?
- (3) What differences, if any, exist among students who select different major fields of study in the College?
- (4) What differences, if any, exist between students who enroll in the College of Education as freshmen and later graduate, and students who enroll as freshmen in the College and do not graduate?
- (5) What differences, if any, exist between students who transfer into the College and later graduate, and those who pursue all their work while enrolled in the College of Education and later graduate?

Based upon the findings of this study, the following general conclusions were drawn concerning the student population in the College of Education at the University of Alabama during the period 1955-59.

1. Less than one-third of the students who enrolled in the College of Education as freshmen in 1955 persisted in the College until graduation in 1959. Only 10.1 per cent of those lost between enrollment and graduation were actually dropped for poor scholarship, though it must be assumed

that lack of academic success probably prompted some other students to drop out.

2. Most of the significant differences reported in this study can be ascribed to patterns of difference observed in comparisons between the sexes. The preponderance of females in the Elementary and Vocational major fields of study, and the preponderance of males in the subject-matter majors included in the Twelve Year major field of study were probably representative of differences in motivation and opportunities for vocational satisfaction which are more closely related to sex than to the curricula. Differences in mean scores on the ACE examination were clearly defined along sex lines as were differences in scholastic achievement.

3. If an element exists within the total student population in the College of Education which tends to lower the performance of the whole group, it must be concluded on the basis of this study that it is the male students, on the whole, who are inferior.

Knowledge of the characteristics of the student body should be helpful to administrators and teachers in planning curriculum revisions. Knowledge of attrition probability should be helpful in counseling with students who might otherwise be lost to the profession, or with students who might be better served by preparation for other vocations. Recruitment practices and admission policies can be strengthened by information relating to certain characteristics of various subgroups within the population of the College of Education.

Microfilm \$2.50; Xerox \$8.80. 192 pages

AN EVALUATION OF TEACHERS TRAINED  
UNDER THE INTENSIVE PROGRAM  
FOR COLLEGE GRADUATES

(L. C. Card No. Mic 60-5242)

George Magrath, Ph.D.  
The University of Connecticut, 1960

The Problem. The purpose of this investigation was to compare the teaching effectiveness of teachers trained under the Intensive Program for College Graduates with the effectiveness of teachers trained under the regular four-year teacher training program.

Sources of Data and Procedure. This study was limited to those teachers who had been placed in some twenty-eight communities which were under the supervision of Central Connecticut State College at New Britain. The teachers who were trained at this college were selected for several reasons. It was believed that the groups under investigation should be controlled in so far as their professional training and background were concerned. By selecting one institution, there would be fewer variables involved, since everyone in the group would have been exposed to a common philosophy and approach to the teaching process. However, in order to secure a large enough sampling, it was necessary to select a large teacher training institution.

The groups which were compared were the "intensive" teachers and "regular" graduates of Central Connecticut State College for the years 1956, 1957 and 1958.

The names and location of the total population were obtained from the administrative offices of Central Connecticut State College, the certification office of the State Department of Education and the files of local superintendents of schools.

There were 444 teachers for whom evaluation forms were distributed, and returns were made on 381 teachers. Of these, 245 were "intensive" teachers and 136 were "regular" graduates of Central Connecticut State College. The evaluations were completed by the professional supervisors in the separate communities and data were compiled on the basis of these evaluations.

It was believed that the evaluation instrument selected should be comprehensive enough to include all the commonly accepted criteria for effective teaching. It should also conform to accepted standards of objectivity, and simplicity in administering and scoring. Furthermore, tests of reliability and validity must have been satisfied. "The Teaching Evaluation Record" by Dwight E. Beecher satisfied these criteria and was chosen as the measuring instrument of the study.

**Conclusion.** A year by year comparison of the mean scores obtained by "regular" and "intensive" teachers indicated that the "regular" teachers scored consistently higher than "intensive" teachers. However, upon examining specific pairs of means, these differences were not statistically significant.

An item by item comparison of the ratings obtained by the "regular" and "intensive" teachers indicated that the "regular" teachers consistently scored higher than the "intensive" teachers on the thirty-two items of the evaluation "Record."

Another indication of the superiority of the "regular" teachers was shown in the comparison of the distribution of the scores made by each group. Whereas 8 per cent of the "intensive" group (nineteen teachers) scored below the 50 per cent level, only seven-tenths of 1 per cent of the "regular" group (one teacher) were so rated.

The data in this study showed that the "intensive" teachers were more mature than the regularly trained people. In spite of this maturity, they were less effective. It must also be remembered that the regularly trained teachers had only four years of college training while the emergency trained teachers had four years plus the eight-week summer session before beginning to teach, and had completed virtually five years of training by the time they had completed their emergency service. Although these two factors operated in favor of the "intensive" teachers, they still were not able to score as high as the regularly trained teachers.

Microfilm \$2.50; Xerox \$7.00. 146 pages.

# A STUDY OF PROFESSIONAL LABORATORY EXPERIENCES PROVIDED FOR PROSPECTIVE ELEMENTARY SCHOOL SISTER-TEACHERS

(L. C. Card No. Mic 60-5404)

Sister Ann Myra Seaver, S.N.J.M., Ed.D.  
University of Oregon, 1960

Adviser: Ruth A. Willard

This study presents a description, analysis and evaluation of the professional laboratory experiences provided by religious communities of Catholic Sisters in the teacher-education programs for their prospective elementary school Sister-teachers. It seeks to determine to what extent these programs conform to criteria established by a jury of well-known educators.

Data on the professional laboratory experiences are secured through a questionnaire completed by 122 administrators of religious communities of Sisters. Survey responses provide information relative to: (1) the organization and administration of laboratory experiences including directed observation in classroom situations, group leadership activities with children, the "September experience" and student teaching; (2) opportunities for assuming the teacher's role during student teaching; (3) evaluation and follow-up; (4) laboratory school facilities; and (5) preparation and responsibilities of the personnel involved in the program. The administrative centers of the institutions which the 122 survey respondents represent are located in 30 different states sampling all geographical areas of the United States. The 4500 elementary schools staffed by members of the various religious communities are distributed over 48 states.

An important aspect of the investigation is the set of criteria for professional laboratory experiences developed from a study of pertinent current literature. In order to validate these guiding principles, they were presented to a jury of six lay and five Sister teacher-educators for their reactions to each in terms of agreement, agreement with reservation, or disagreement. The ensuing standards are applied in evaluating the questionnaire data. Results of the appraisal are reported according to the number and per cent of total groups meeting each criterion and the number of individual programs meeting or approximating the complete criteria. In addition, ten individual programs, which constitute a random sample of the whole, are described in detail.

Results of this study show that there is close agreement among the jurors on all criteria except those relating to the duration of the student-teaching assignment, the student's freedom from other college responsibilities during this assignment, the type of elementary school used for student teaching, and the sharing of responsibility for placing student teachers. All jurors emphasize the need for high quality in the laboratory experiences.

More than 50 per cent of the institutions reporting data appear to meet all of the criteria with the exception of four standards. The criteria, when applied to the data of the study, adopt the following order based on the frequency with which the survey groups, in terms of per cent, conform to the criteria: (1) Supervision of student teachers should be a joint responsibility, 93.7 per cent of the groups. (2) College supervisors should have elementary



school teaching experience, 92.9. (3) The college should cooperate in selecting the laboratory situation, 88.4. (4) There should be opportunities for directed observation, 78.7. (5) Observation should be integral to course work, 75.4. (6) Student teachers should participate in the teaching and non-teaching duties of the classroom teacher, 75.0. (7) Group leadership experiences should be provided, 68.9. (8) Placement of student teachers should be a cooperative responsibility, 68.4. (9) Evaluation should be cooperative and continuous, 65.9. (10) Preliminary experiences should include participation in teaching situations, 58.2. (11) Student teaching should extend for at least one semester and should include some full-time experience, 32.0 and 39.2. (12) Post-student teaching laboratory experiences should be provided, 36.1. (13) Student teachers should survey the school neighborhood, 12.9.

Microfilm \$2.90; Xerox \$10.15. 222 pages.

#### THE IDENTIFICATION OF MANAGEMENT DECISIONS IN FARM MECHANICS NEEDED BY FARM OPERATORS IN VIRGINIA

(L. C. Card No. Mic 60-6471)

Evans Guy Thompson, Ed.D.  
Cornell University, 1960

The changes in farming practices resulting from the spectacular increase in farm mechanization since 1940 have emphasized the importance of managerial as well as manipulative abilities in farm mechanics in operating a farm business.

Purposes of the study. The purposes of the study were to:

1. Determine the management decisions in farm mechanics in which instruction was being provided by teachers of vocational agriculture in Virginia.
2. Develop a comprehensive list of management decisions in each educational area in farm mechanics that farmers in Virginia have to make in managing their farm businesses.
3. Determine which management decisions in each educational area in farm mechanics should be included in the instructional program in vocational agriculture in Virginia.
4. Prepare a list of management decisions in each educational area in farm mechanics that teachers of vocational agriculture in Virginia could use as a guide in preparing their courses of study.

Scope of the study. Data were secured from 191 teachers of vocational agriculture representing 80 counties and 154 local communities in Virginia, 82 high school seniors enrolled in vocational agriculture, 44 farmers, and 15 farm machinery dealers representing 10 selected local communities in Virginia, and 37 farm mechanics specialists representing 37 states in the United States.

Procedures used in making the study. Schedules were developed to secure the opinions of each population group on the decisions in each of the five educational areas in farm mechanics on importance, frequency of occurrence,

the degree to which they were common problems of farmers, and the instruction recommended in the vocational agriculture program.

Summary. General farming was the major type of farming represented by teachers, students, farmers, and farm machinery dealers in Virginia, while dairying was the major type in the states represented by the farm mechanics specialists.

Twenty-seven of the 88 decisions in farm mechanics rated average on all factors and instruction was recommended to all groups in vocational agriculture by 75 per cent or more of the respondents, 38 rated average and instruction was recommended by 50 to 75 per cent, and 23 either rated below average or instruction was recommended by less than 50 per cent or both.

The teachers, farm mechanics specialists, and farm machinery dealers indicated that the management decisions in farm mechanics were more important and occurred more frequently in operating a farm than the students and farmers indicated. A higher percentage of the students, farm mechanics specialists, and farm machinery dealers recommended instruction in the decisions to all groups in vocational agriculture than the percentage of the teachers and farmers.

The 27 decisions that rated average on all factors and in which instruction was recommended to all groups in vocational agriculture by 75 per cent or more of the respondents should be strongly considered for inclusion in the instructional program in vocational agriculture in Virginia.

The 38 decisions that rated average on all factors and in which instruction was recommended to all groups in vocational agriculture by 50 to 75 per cent of the respondents should be considered for inclusion in the instructional program in vocational agriculture in Virginia in terms of other units of instruction of average importance to farmers.

The 23 decisions that either rated below average on all factors or in which instruction was recommended to all groups in vocational agriculture by less than 50 per cent of the respondents or both should not be included in the instructional program in vocational agriculture in Virginia except in special situations where the local needs dictate that they be included.

Microfilm \$5.20; Xerox \$18.45. 406 pages.

#### EDUCATION, THEORY AND PRACTICE

##### CHANGES IN PROFESSIONAL ATTITUDES IN A GROUP OF LATIN AMERICANS PARTICIPATING IN A BI-LINGUAL EDUCATION PROGRAM

(L. C. Card No. Mic 60-5412)

Anthony Nicholas Baratta, Ed.D.  
The Pennsylvania State University, 1960

Adviser: Dr. Gerald Bosch

The purpose of this study was to ascertain the changes in professional attitudes which occurred in a group of

14 Latin American educators in a bi-lingual education program. Specifically, the investigation sought to determine whether attitude changes occurred to indicate increased understanding of principles which foster desirable teacher-pupil relationships, and whether there were attitude changes concerning opinions reflecting increased teacher effectiveness concerning elementary school teaching practices. A third phase of the study sought to determine whether attitude changes occurred which yield an estimate of increased democratic tendencies at the personality level.

The measure of attitudes toward teacher-pupil relationships selected for use was the Minnesota Teacher Attitude Inventory, by Cook, Leeds, and Callis. This 150 item inventory was designed to measure those attitudes of a teacher which predict how well he will get along with pupils in interpersonal relationships. A high score implied ability to establish harmonious relationships with pupils.

The measure of attitudes reflecting teacher effectiveness selected for use was the Evidence of Teacher Opinion, by Byron White. This 28 situations test was designed to measure teacher effectiveness through a projective technique. A high score implied greater professional competency.

The measure of attitudes indicating democratic tendencies selected for use was the Adorno F-Scale, by Adorno and associates. This test was composed of 29 items from a number of areas scientifically selected and defined as a more or less central trend in the person, which in accordance with some dynamic process, expresses itself on the surface in ethnocentrism as well as in diverse psychologically related opinions and attitudes. A low score implied high democratic tendencies. The three tests were administered in Spanish.

Twenty-five MTAI topics were discussed by the Latin American educators during special discussion sessions. This was one of the conditions for changing professional attitudes in the area of teacher-pupil relationships. After the discussion sessions, brief essays were written concerning the same topics. Several weeks before the end of the program, structured interviews were conducted by the researcher concerning seven of the topics that had previously been discussed during the special discussion sessions.

The procedure followed employed the use of the pre- and post-test technique of the Spanish translated MTAI, WETO, and F-Scale. The results of these tests were analyzed according to standard statistical procedure. The oral and written statements were content analyzed for subsequent statistical analysis.

Consideration of the data permitted the drawing of the following conclusions.

The study lent support to the thesis that selected changes in professional attitude occurred in a group of Latin American educators, as a possible outcome of the Geneseo bi-lingual education program. More specifically, there were positive attitude changes in the area of teacher-pupil relationships and teacher effectiveness related to elementary school teaching practices.

On the other hand, positive attitude changes did not occur in the Latin American educators to indicate greater democratic tendencies at the personality level perhaps because the Latin American educators were similar to

their North American associates with respect to these democratic tendencies.

Microfilm \$2.50; Xerox \$8.00. 173 pages.

# AN INVESTIGATION AND ANALYSIS OF LABORATORY EXPERIENCES IN EARTH SCIENCE

(L. C. Card No. Mic 60-4826)

James William Batten, Ed.D.  
The University of North Carolina, 1960

Supervisor: John B. Chase, Jr.

The purposes of this study were: (1) to determine the extent to which earth science is emphasized and developed in typical high schools in North Carolina, either as a course or as opportunities in other sciences, and (2) to identify and design basic laboratory experiences which emphasize the interrelationships of the functional and intellectual concepts of the earth to basic biological and physical concepts and which provide opportunities for solving problems and developing scientific attitudes and interests.

Procedure: The procedure followed in conducting this study was that of (1) reviewing the literature related to the development of earth science as a course or as opportunities in other science courses, (2) identifying earth science units and concepts in selected textbooks, laboratory manuals, and bulletins, (3) selecting the criteria upon which the laboratory experiences were developed, (4) designing the experiences, (5) analyzing the experiences by trying them in selected classrooms to determine the general reactions of students relative to interest, time, equipment, supplies, and degree of difficulty, (6) seeking the opinions of college professors to obtain their reactions concerning the difficulty of material, nature and scope of experiences, understanding of concepts, and equipment needed, and (7) distributing the experiences to teachers in the National Science Institute to obtain their opinions concerning practicability, interest, time, equipment and supplies, relatedness, degree of difficulty, and contribution to the development of understanding.

Findings: Earth science was not included in the curriculum prior to 1900 except as individual courses in astronomy, meteorology, and geology. In addition to these courses, emphasis was directed to physical geography and physiography until the end of World War II. Then earth science found its way into the curriculum and has accelerated slowly but continuously since that time.

Ten administrative units in North Carolina offer a course in earth science, eight units offer a modified course, integrating it in general science, and eight units are planning to incorporate a course in earth science in the near future.

All science textbooks used in North Carolina have specific units on earth science except the chemistry texts and one physics text, and they have presented opportunities for the development of earth science concepts. The units



developed in the science texts revealed six basic earth science concepts. They are listed as follows: (1) The earth is a member of the solar system, which is a minute part of the galactic system. The two systems are inter-related, and activities concerning their nature result because of this interrelationship. (2) The location of man and his attitudes and activities are dependent upon the natural forces operating on the earth. (3) Climatic and weather conditions result from atmospheric disturbances. (4) Oceans, seas, and bodies of water have characteristic influences on weather and climate. The erosive activity of water produces changes in land surfaces and features. (5) Mountains, valleys, peneplains, and other landforms and features result from structural and gradational processes over long periods of time. (6) Rocks, minerals, and metals found in the earth's crust result from the combination of the various elements.

A try-out of the eighteen selected experiences proved to be favorable. Some were completed in one class period while many periods were required for others. The material was of sufficient difficulty to attract the average student and proved adequate for challenging the more able students.

College professors and teachers felt that the nature and scope of the experiences and opportunities for developing understandings seemed sufficient. Elaborate equipment was not required, and the "Word List for Study" and "References" would be advantageous to students.

Conclusions: (1) Earth science courses, units, and concepts are being taught in the secondary schools of North Carolina. (2) Selected teachers felt that schools have adequate facilities, supplies, and equipment to teach earth science. (3) Superintendents are unaware that earth science units are included in science textbooks in secondary schools since only eight reported that earth science units or concepts were being taught. (4) There is inconsistency in the inclusion of earth science topics found in selected textbooks. (5) Since some books are repetitious and others omissive, too much depends on the teacher for the development of earth science. (6) The eighteen selected experiences present opportunities for students to develop scientific attitudes and problem solving techniques. Also, many opportunities are included for students to use source materials, dictionaries, reference books, and encyclopedias.

Microfilm \$3.45; Xerox \$12.15. 266 pages.

#### WORD ANALYSIS SKILLS IN THE INTERMEDIATE GRADES

(L. C. Card No. Mic 60-5584)

John Peter Deasy, Ed.D.  
Boston University School of Education, 1960

#### The Problem

The purpose of the study was (1) to determine which word analysis skills are emphasized in the intermediate-grade programs of current basic reading series and (2) to examine the relationships of these skills to reading and spelling achievement.

#### Procedure

A survey was made of the workbooks of six basic reading series and four supplementary phonics series. The word analysis exercises were classified and tabulated. Nine word analysis tests were prepared to measure skills emphasized in these workbooks. Six of these tests (Syllabication, Accent, Root Words and Compound Words, Prefixes and Suffixes, Vowel Sounds, and Diacritical Marks) followed the pattern of typical workbook exercises. The Auditory Test (identifying sounds in spoken words), Visual Test (identifying words from visual memory), and Recognition of Homophones test (identifying different groups of letters having the same sound) measured skills related to those in workbooks. The Vocabulary and Level of Comprehension sections of the Gates Reading Survey, the Spelling List of the Stanford Achievement Test, Form E, and the Beta Test, Otis Quick-Scoring Mental Abilities Tests served as measures of reading and spelling achievement and mental age. Skill in word attack was measured through two individual pronunciation tests: the Boston University Word Pronunciation Test, and a dictionary spellings test.

These tests were administered in Grades Four, Five, and Six and complete data were secured for 298 cases. All tests were hand scored and the data recorded and coded for transfer to standard IBM cards. Machine processing provided frequency distributions, means, standard deviations, and intercorrelations of all tests. First-order partial correlations with mental age and reading comprehension constant and reliability checks were the other statistical techniques employed.

#### Findings and Conclusions

1. Intermediate-grade, reading workbooks tend to provide the following types of word analysis practice: (1) consonant sounds, (2) vowel sounds and principles, (3) root words, compounds, and endings, (4) prefixes and suffixes, (5) syllabication, (6) accent, (7) diacritical marks and dictionary spellings, and (8) visual discrimination or visual memory of word patterns. In the twenty-one reading workbooks analyzed, the number of exercises for a particular skill at one grade level ranged from one to seventeen, with the median number of exercises being four or less.
2. The findings indicate important relationships between three word analysis skills (recognition of homophones, interpretation of diacritical marks, and visual memory) and ability in both word pronunciation and spelling.
  - a. When the word analysis skills are compared with word pronunciation while reading comprehension is held constant, twenty-six out of twenty-seven correlations are significant at the .01 level. Median correlations with word pronunciation are as follows: visual memory, .699; homophones, .669; diacritical marks, .666; root words, .464; prefixes and suffixes, .378; syllabication, .366; vowels, .337; accent, .322; identifying sounds, .295.
  - b. When the word analysis skills are compared with spelling while reading comprehension is held constant, twenty-five out of twenty-seven correlations

are significant at the .01 level. Median correlations with spelling are as follows: homophones, .649; diacritical marks, .587; visual memory, .579; root words, .502; identifying sounds, .426; prefixes and suffixes, .394; vowels, .331; syllabication, .301; accent, .288.

3. When reading comprehension is held constant, the word analysis skills tend to relate more closely to word pronunciation (median correlation .464) and to spelling (median correlation .446) than to reading vocabulary (median correlation .301). Ability to combine prefixes and suffixes with word-roots in a meaningful context appears to be the only exception to this trend.
4. Reliability coefficients of the informal word analysis tests, determined by use of the Kuder-Richardson Formula #21, ranged from .743 for syllabication to .963 for Vowel Sounds.

Microfilm \$3.45; Xerox \$11.95. 265 pages.

#### THE PREDICTION OF SUCCESS IN EIGHTH GRADE ALGEBRA

(L. C. Card No. Mic 60-5187)

Roger Lee Duncan, Ed.D.  
The University of Oklahoma, 1960

Supervisor: Professor Glenn R. Snider

The inclusion of algebra in the eighth grade in the curricula of many secondary schools has created a need for some means of identifying students who are likely to be successful in algebra at this level. The problem, therefore, was to study and isolate factors which contribute to success in algebra in the eighth grade and to attempt to develop a multiple regression equation which would predict academic success in eighth grade algebra.

Two classes of eighth grade students enrolled in algebra courses at the Norman Junior High School, Norman, Oklahoma, served as subjects for this study. They were given a battery of standardized tests at the end of their seventh year in school, and the results along with other factors served as predictor variables for the study. At the end of the first semester of instruction the Seattle Algebra Test, with norms developed from scores made by students enrolled in ninth grade algebra, was administered. The results of this test served as criterion of success in algebra.

Intercorrelations were computed for the twenty-one predictor variables and the criterion variable. A multiple regression equation was developed by use of the Wherry-Doolittle Method, which permits the selection of the best predictors and makes unnecessary the selection of additional variables which cannot contribute to the efficiency of the formula. All but four of the predictor variables were eliminated. The resulting formula was

$$\bar{X}_1 = .313X_5 - .165X_{21} + .137X_2 + 1.841X_9 - 23.18$$

where  $\bar{X}_1$  was the best estimate of a particular student's score on the Seattle Algebra Test,  $X_5$  was his general intelligence quotient,  $X_{21}$  was the summation of his inter-

est scores in science and literature,  $X_2$  was his score on the Orleans Algebra Prognosis Test,  $X_9$  was his grade placement in arithmetic computation, and 23.18 was a constant.

The corrected multiple correlation coefficient,  $\bar{R}$ , was .7600, and the standard error of the estimate was 3.74.

The experimental classes scored well on the Seattle Algebra Test; in fact, 89% of the students scored above the mean of the norms for ninth graders. This seemed to indicate that comparable groups of bright eighth graders generally could be expected to achieve in algebra as well as or better than unselected groups of ninth grade pupils.

It is recommended that the multiple regression equation developed in this study be utilized by secondary school administrators and teachers to help identify students who are likely to be successful in eighth grade algebra.

Microfilm \$2.50; Xerox \$3.00. 53 pages.

#### ATTITUDES OF SECONDARY SCHOOL SUPERINTENDENTS, PRINCIPALS, GUIDANCE COUNSELORS TOWARD SOME ASPECTS OF HOME ECONOMICS.

(L. C. Card No. Mic 60-6110)

Frances S. Goldsmith, Ph.D.  
Purdue University, 1960

Major Professor: H. H. Remmers

The purpose of the study was to find answers to these pertinent questions:

1. What were the attitudes held by secondary school superintendents, principals, and guidance counselors toward aspects of home economics?
2. Did they differ
  - a. Between these three groups of secondary school administrative personnel?
  - b. In an unfavorable or a favorable direction?
  - c. In communities of different sizes?
  - d. According to geographic region represented?
  - e. According to the size of community represented?
  - f. According to the size of the school population?
  - g. According to the age of the respondents?
  - h. According to the length of experience of the respondents?
  - i. According to the percentage of the school graduates who went to college?
  - j. According to the breadth of the home economics program in the schools?
  - k. According to whether ratio of enrollment in home economics to other subjects had gone up, down, or remained the same within the past five years?

Answers to these questions were sought by means of an Opinionnaire and Information Sheet devised and mailed to 750 secondary school superintendents, 750 principals, and



500 guidance counselors believed to be representative of the 40,000 superintendents and principals and the 14,000 counselors listed in government reports. The sample was stratified according to geographic area and size of community.

There were 75 statements reflecting attitudes toward home economics--the teachers, the curriculum and administration. Information about age, experience, size of community and school, home economics enrollment and breadth of program, and other items basic to the hypotheses was requested.

Fifty experts in home economics were asked to rate the importance of the items and criticize. A trial run sample of 100 secondary school administrators was asked to answer and criticize the instruments.

The subjects were asked to rate each attitude statement on a four-point scale according to a level of agreement.

Completed responses were received from 1391 individuals, 512 superintendents, 544 principals, 355 guidance counselors from different regions of the United States, from different sizes and types of schools and communities.

Mean scores and standard deviations were:

1. Superintendents	231.4	24.3
2. Principals	234.1	26.6
3. Guidance Counselors	231.4	26.2

These were not significantly different.

The attitudes were more favorable than unfavorable on 44 of the 75 statements, more unfavorable than favorable on 14 of the statements; there were significant differences in the support of 17 statements.

Brief summary of favorable attitudes includes:

1. Teachers set good examples of principles they teach, hold high ideals for family life, are enthusiastic, competent, professional.
2. The curriculum is well suited to adolescents' needs, should be retained in the schools when it is broad in scope and provides opportunity for stimulating learning.
3. Administrative procedures are good, costs are in line. Credit earned should be equal to that of other subjects.

Major unfavorable attitudes referred to the teachers' outside interests, personality, public relations, curriculum stress on cooking and sewing, and duplication of material at different levels.

No statistically significant differences were found in hypotheses 2, c - j stated earlier.

A difference was found significant at the .01 level in hypothesis k., whether ratio of home economics enrollment had gone up, down or remained the same from 1954-1959.

The educational background of the sample varied in the types of institutions attended. More counselors attended private institutions than did the other respondents as undergraduates. For graduate study, a large majority of all groups chose state universities.

More principals and superintendents than counselors majored in the social and physical sciences as undergraduates; all groups supported the area of specialization most closely aligned to their professional work at the graduate level.

In the schools represented by the sample, home economics was more frequently required in the 7th and 8th grades than in the 9th - 12th grades.

Microfilm \$2.55; Xerox \$8.80. 195 pages.

# A STUDY OF SCIENCE TEACHING IN GRADES SIX THROUGH EIGHT IN SELECTED TEN-YEAR SCHOOLS OF THE U.S.S.R.

(L. C. Card No. Mic 60-5816)

John Millard Harmon, Jr., Ed.D.  
Boston University School of Education, 1960

**Problem.**-- This study seeks to examine procedures in the teaching of science in grades six through eight in schools accessible to the writer within the Soviet Union.

**Procedure.**-- Schools were visited in Moscow, Leningrad, Kiev, and Irkutsk. During visitations to 14 schools, 42 classrooms were observed, 16 of which were science classrooms.

An Administration Questionnaire, designed to furnish background data on the school, teachers, and curriculum, was completed by interview. A Science Class Checklist, designed to provide observed information on the class, equipment, teaching and evaluation techniques, and the teacher, was completed for each science classroom visited in grades six through eight. A General Class Checklist, similar to the Science Class Checklist with the omission of laboratory equipment, was completed when visiting other classes. Classroom visitations and administrative interviews were documented by photographs.

**Results.**-- In the science classrooms visited:

1. The average number of pupils was 29.
2. Thirteen per cent did not have a laboratory demonstration table.
3. Nineteen per cent had student tables adapted for laboratory use.
4. Seventy-five per cent had running water available.
5. Fifty-six per cent had gas available.
6. One hundred per cent had electricity available.
7. Thirteen per cent had a hood and exhaust fan available.
8. Lecture-demonstration was observed as a teaching technique in all classes.
9. Reciting on a memory assignment was used as a teaching technique in 63 per cent of the classes.
10. Questioning was used as a teaching technique in 75 per cent of the classes.
11. Blackboard recitation was used as an evaluation technique in 56 per cent of the classes.
12. Copybooks were used in 69 per cent of the classes.
13. No formal testing was observed.

**Major conclusions.**-- The following major conclusions were drawn from this study:

1. The lack of horizontal correlation of science material in the Soviet curriculum indicates strong departmentalization of subject matter.
2. The strong vertical correlation of science material indicates a standardized schedule of presentation.
3. The lecture-demonstration method of science teaching observed was not accompanied by any individual project work.
4. The extensive use of board recitation based on homework seen in the science classrooms visited indicates a probable lack of provision for thought-provoking student science projects.
5. In science classrooms visited, the extensive use of copybooks indicates that a type of rote teaching and memory work was extensively used.
6. The teaching methods observed in the science classes visited in this study indicates that the program is directed more toward "training" than toward a comprehensive science education for the pupils.
7. Science classrooms visited were well equipped.
8. The presence of gymnasium and playground facilities at all schools visited indicates that interest in science has not resulted in the exclusion of other curricula in Soviet schools.
9. The predominance of schools on double session may indicate a shortage of school buildings.
10. The 18 hours per week taught by science teachers in grades six through eight in the Soviet Union is an indication of a light teaching load.
11. Science teachers observed were well trained.
12. The science program as observed in Irkutsk, Siberia, indicates that distance from Moscow does not diminish central control.
13. A central source of science textbooks helps to produce uniformity in the science curriculum of the Soviet Union.
14. The compliance in schools visited with the 1955 Politburo decree regarding driver education indicates the rapidity with which change could be effected in the science curriculum.

Microfilm \$2.90; Xerox \$10.15. 223 pages.

THE DESIGN AND ANALYSIS OF  
LABORATORY EXPERIENCES IN  
HIGH SCHOOL CHEMISTRY

(L. C. Card No. Mic 60-4842)

Paul Barryman Hounshell, Ed.D.  
The University of North Carolina, 1960

Supervisor: John Bryant Chase

Individual laboratory work is as essential to science teaching as it is to science, for the primary purpose of laboratory work is to aid in development of basic scientific

concepts. To do this, laboratory work must cause the student to think, to reason, and to form associations. Because high school teachers of chemistry and college professors of chemistry and science education have indicated the failure of high school chemistry laboratory courses to achieve maximum understanding of chemical concepts, this study was undertaken in an attempt to identify more satisfactory methods of designing laboratory experiences for high school chemistry. The purposes of this study were to identify concepts basic to the study of chemistry and to design laboratory experiences for high school chemistry which develop functional and intellectual concepts basic to the study of chemistry, which utilize the problem solving approach, and which can be adapted to a high school program.

The procedure followed in conducting this project was that of reviewing the literature related to this topic, identifying basic chemical concepts, and designing and analyzing high school chemistry laboratory experiences.

From an analysis of elementary and junior high school science textbooks, high school and college chemistry textbooks and laboratory manuals, and related literature, the following chemical concepts were identified as basic to high school chemistry: (1) All matter is composed of atoms which exhibit characteristics enabling them to be classified and grouped according to their individual characteristics, (2) the structure and internal energy of atoms cause them to combine to form molecules of various compounds each with its particular characteristics, and (3) by controlling external conditions of reactions, products from changes of atoms, molecules, and compounds and the energy involved can be utilized.

To serve as guides in the design and organization of laboratory experiences which could lead to understanding of the above chemical concepts, the following criteria were selected: (1) Contribution of the experiences to the understanding of chemical concepts, (2) opportunities provided for the solution of problems, (3) the adaptability of the problems to various experience levels, such as subject matter maturity, group and individual interests, and abilities of students, (4) equipment necessary to carry out the experience, and (5) time required to carry out the experiences. Using these criteria, twenty-three laboratory experiences were designed which, by their organization, would lead to an understanding of basic chemical concepts, would cause students to become involved in problem solving situations, would be adaptable to individual interests and abilities, and could be adapted to time and equipment limitations.

Each of the twenty-three experiences was analyzed by a panel of high school chemistry teachers and college professors of chemistry and science education in order to determine their apparent effectiveness in terms of the selected criteria. In addition, a class of high school chemistry students performed the experiences under the guidance of the writer. On the basis of opinions of the participants in the study, the twenty-three experiences were considered effective in terms of the selected criteria.

The findings of this study indicated that high school chemistry laboratory programs should be organized around problems which provide opportunities for students to become totally involved in their solution and that experiences should be designed to allow students maximum freedom of thought and activities. Students should be given ample time and adequate facilities to determine



experimentally factors relating to the solution of problems, to obtain and record significant data, and to analyze this data as it relates to the problem. The total high school chemistry program as well as chemistry in all lower grades should be directed toward the formation of expanding understanding of chemical concepts.

Microfilm \$3.90; Xerox \$13.75. 301 pages.

**A CRITICAL ANALYSIS OF THE PROMOTION  
OF THE CONSISTENCY OF ACTIONS  
AND BELIEFS OF PUPILS AS ONE ASPECT  
OF INTEGRATING PRACTICES  
IN THE JUNIOR HIGH SCHOOLS**

(L. C. Card No. Mic 60-5239)

Harold Judenfriend, Ph.D.  
The University of Connecticut, 1960

**STATEMENT OF THE PROBLEM**

The problem of this study is: What is the relationship between certain selected factors in junior high schools in Connecticut and the development in pupils of a consistency of actions and beliefs with respect to certain social problems?

**DEFINITION OF INTEGRATION**

Integrating behavior is behavior that is directed toward a goal, that shows a consistency of actions and beliefs, that seeks to organize and to interrelate all experiences in a meaningful way, that is socially constructive, that is interactive with the social and physical environments and that is continuous and lifelong.

**SCOPE OF THE STUDY**

Although the present study is concerned with the integration function of the junior high school, it is directed toward only one aspect of the integrating behavior of pupils, namely the consistency of actions and beliefs of pupils with respect to certain social problems.

Only a few of the factors which may bear a relationship to the development of the consistency of actions and beliefs of pupils were studied. These factors were: (1) emphasis on the integration function in the program of the school, (2) type and location of community, (3) occupational status of parent, and (4) emphasis on certain social problem areas in the instructional program.

Only separately-organized three year junior high schools, including grades 7, 8, and 9 were selected. The pupils included in this study were drawn from the ninth grade in each of the seven schools studied.

**PROCEDURES EMPLOYED**

Five major steps were followed in conducting this study:

Step I - A definition for the term "integration," as a basis for this study, was developed from the literature on the subject.

Step II - The schools to be included in the study were

selected from a list of all three-year junior high schools listed in the Educational Directory of Connecticut for 1956-57.

Step III - Information was obtained through a directed interview of the principals of selected schools concerning instructional practices used in these schools to develop a consistency of actions and beliefs of pupils and therefore to implement an aspect of integration.

Step IV - The degree of consistency of actions and beliefs in certain social problems of a random sample of ninth grade pupils in each of the schools was ascertained by the administration of the Social Problems Test Form 1.42, developed by the Progressive Education Association for the Eight Year Study.

Step V - The differences in the extent of consistency of actions and beliefs in the seven schools studied were then analyzed in terms of certain selected factors as stated above.

**CONCLUSIONS**

1. A combination of factors, rather than any one factor above, bear a relationship to the consistency of actions and beliefs of pupils with respect to social problem areas.

2. Any given factor may not have the same influence on the promotion of actions and beliefs of pupils for all social problem areas.

3. There is a slight indication that pupils in schools with high occupational status of parents tend to be more consistent in actions and beliefs than are pupils in schools with low occupational status of parents.

4. There is no indication of a clear relationship between the attention given to social problem areas in the instructional program of the school and the promotion of consistency of actions and beliefs in those areas.

5. There may be other factors which are as important, or more so, in promoting a consistency of actions and beliefs of pupils than those selected for this study.

6. The consistency of actions and beliefs of pupils in the seven schools studied is developed not just by chance, but that factors in the program of the schools, in the community and in the background of the pupils have a definite bearing on it.

Microfilm \$2.50; Xerox \$7.80. 166 pages.

**A STUDY OF THE WRITING OF NUMERALS**

(L. C. Card No. Mic 60-5669)

Mary Viola Kahrs, Ph.D.  
State University of Iowa, 1960

Chairman: Professor Herbert F. Spitzer

The purpose of this study was to accumulate data and information concerning the numeral forms presently used in writing Hindu-Arabic numerals through (1) a survey of adult writing of numerals to determine common usage; (2) an experimental study of the legibility of selected numeral forms; and (3) a quality rating of numeral forms written by intermediate grade pupils to determine rater preference. Included in the study was an analysis of the numeral forms presented in recently published handwriting and arithmetic books for grade three.

Investigation I, to obtain information concerning numeral forms in common adult use, was accomplished by means of a questionnaire-type survey in which three-hundred forty-eight adults provided data regarding the numeral forms they used. To facilitate the collection of data, materials were prepared containing a series of exercises to provide each subject with copies of his numeral writing, for use in conjunction with a self-classification sheet for categorizing the numerals according to form.

Analysis of the data appeared to support the conclusions that (1) a great diversity exists among the forms used by adults in writing numerals; (2) slant forms appeared to be most common; and (3) a large majority of the subjects reported making the numeral for six the same height as the other numerals and ending the numerals for seven and nine on the base line. If this sample is representative of the adult population as a whole, one may question whether the forms commonly found on handwriting charts in elementary classrooms, for these numerals, are in keeping with everyday use.

For Investigation II, a tachistoscopic method of projection was used to conduct an experimental study of the legibility of selected forms for the ten numerals to determine whether or not form may be a factor in the legibility of written numerals. Selected numeral forms were written on slides and presented to intermediate grade subjects. Three ways of presenting the numeral forms by this technique were attempted: in a five-place series, as single digits; and in sentences.

Under the conditions used in this study, the five-place series presentation appeared to be most satisfactory for determining differences in legibility. Statistical analyses for a sample of one-hundred fifty subjects, drawn at random from a larger sample of one-thousand ninety-six participants, indicated differences in legibility among the means for the numeral forms presented for one, two, three, four, six, seven, and eight. In view of these analyses it was concluded that: (1) numeral form may be a factor in legibility for some of the numerals (2) A comparison of means for the forms of those numerals where differences were found, indicated that vertical and simply written forms were highest in legibility, but were probably not significantly more legible than some of the slant forms.

Investigation III, designed to secure an indication of rater preference of numeral forms was conducted by means of a quality rating of the numeral writing of intermediate grade pupils. Photographic reproductions of variant numeral forms in differing qualities, taken from the answer sheets for Investigation II, were rated by a sample of fifty experienced teachers. Among the conclusions drawn from an analysis of the data were: (1) highest ratings were primarily given to forms having a slight slant. (2) The numeral forms for seven and nine which extend beneath the base line were not rated as highly as forms ending at the base line.

Microfilm \$2.50; Xerox \$8.40. 184 pages.

## EDUCATIONAL GAMES FOR CLASSROOM USE

(L. C. Card No. Mic 60-5450)

Mignonette Harrison Mountain, Ed.D.  
The Pennsylvania State University, 1960

The main purpose of this study was to test the following hypotheses:

1. Educational games can serve as useful teaching aids in introducing and reinforcing knowledge, attitudes, and skills in language arts, arithmetic, and social science.
2. Educational games can be used effectively for purposeful learnings in grades one through twelve.
3. Educational games can capture, hold, broaden, and deepen the interests of pupils.

The following procedures were used in this study:

1. One hundred educational games and devices were selected for the study. These hundred selected items included commercial games, non-commercial games, and games originated or adapted by the writer.
2. To prepare the games for classroom testing, three items were prepared for each game: directions for playing; suggestions for classroom use; and an evaluation questionnaire.
3. Sixteen public school teachers tested the games in their classes and evaluated them on the questionnaires. These teachers conferred with the writer before and after the testing, and the writer made notes on the opinions the teachers expressed.
4. The data from the questionnaires were tabulated and were then used in the preparation of tables of findings. The data were also used, along with the notes on teacher opinion, in the formation of conclusions and in the revision of the write-ups of the one hundred games.

The main conclusion reached through this study was that all three hypotheses tested in the study were correct. According to the questionnaire data, all one hundred of the games did introduce or reinforce language arts, arithmetic, or social science; all one hundred of the games were evaluated as useful on one or more grade levels, and these grade levels extended from grade one through grade twelve; and ninety-seven of the one hundred games did interest the pupils.

This study has supplied the teaching profession with a source of detailed information on one hundred tested games and devices for classroom use. The information given on each game includes all applicable items from the following list: source; subjects exercised by the game; grades in which the game is useful; numbers of players; manufacturer; equipment; materials for making the game; instructions for making the game; directions for playing; and suggestions for classroom use.

Microfilm \$2.90; Xerox \$10.15. 224 pages.



# AN EXPERIMENT IN A SMALL-GROUP PLAN FOR SPELLING INSTRUCTION IN THE INTERMEDIATE GRADES

(L. C. Card No. Mic 60-5245)

Helen Frances O'Leary, Ph.D.  
The University of Connecticut, 1960

## The Problem

The major purpose of the study was to compare the effect on spelling instruction of the following two methods:

1. A small-group plan in which instruction was differentiated according to pupils' achievement by varying the number and difficulty of words presented for learning.
2. The traditional plan in which the entire ungrouped class used a uniform assignment as prescribed by the basic speller for the grade.

## Procedure

Control and experimental groups, which were equated on the bases of mental maturity, chronological age, and spelling achievement, were established.

In the experimental group of 191 pupils from grades four, five, and six, the small-group plan was used while in the control group of 192 pupils the traditional plan of undifferentiated instruction was continued.

Three matched sub-groups were selected in control and experimental classes in order to be able to compare the effect of the two methods of instruction on children of different levels of achievement. These sub-groups were identified as high achievers, average achievers, and low achievers.

The basic spellers for the grades in question were used as the sole source of content for both control and experimental classes. Fifteen minutes per day for five days per week was the time schedule for instruction in all classes.

In the experimental group classes, the number and kind of words were varied for the average and low achievers, but the high achievers utilized the entire list. Low achievers studied only phonetically true words. Since each weekly list contained a limited number of such words, this method of selection resulted in reducing both the number and kind of words for low achievers. In addition to the words of the low achievers, the average achievers studied approximately six more words chosen to fit the categories of being almost phonetic or considered by pupils to be unusually useful even though highly unphonetic.

Control group classes used the method outlined in the text wherein the entire ungrouped class studied the total weekly list.

At the end of eight months, alternate forms of standardized spelling tests used initially were administered to both groups to measure gains in spelling achievement.

## Conclusions

On the basis of evidence gathered it seemed reasonable to conclude that:

1. The high achievers, who were relieved of drill procedures and who concentrated on word enrichment activities, made a net gain of .255 in grade score more

than the high achievers of the control group. Although the critical ratio of 1.58 indicated this gain was not significant, it still could be assumed that high achievers can develop just as much spelling power when they concentrate on meaning and enrichment activities as when they engage in daily drill in spelling lessons.

2. The gain made by the average achievers in the experimental group was significantly better than the gain of the average achievers in the control group. Thus, one can conclude that such children fare better under a plan of instruction in which the number and difficulty of words are reduced below the normal requirements outlined in typical spelling books.

3. Low achievers in the experimental group showed a net gain of .46 in grade score more than the low achievers in the control group and demonstrated that the low achievers profit most from differentiated spelling instruction which limits the number and kind of words presented for learning.

4. Words considered truly phonetic appear to be suitable for establishing restricted lists for low achievers.

5. Consideration of learning rate in determining vocabulary load in spelling instruction is evidently an important factor.

Microfilm \$2.55; Xerox \$9.00. 196 pages.

# A STUDY OF THE EFFECTIVE UTILIZATION OF A CLASSROOM NEWS MAGAZINE IN TEACHING CURRENT EVENTS

(L. C. Card No. Mic 60-5698)

Clarence William Schminke, Ph.D.  
State University of Iowa, 1960

Chairman: Assistant Professor L. L. Smith

The purpose of this investigation was to determine which of two experimental instructional approaches provided the most effective utilization of a weekly news magazine in teaching current events. Answers were sought to the following questions:

1. Can any significant improvement in current events knowledge be traced to a particular method of instruction?
2. Were shifts in pupil habits and behavior concerning current events discernible as determined through the pre and post-study administrations of a pupil questionnaire?
3. Did a particular approach to instruction yield a greater depth of understanding as subjectively ascertained through tape recorded interviews?
4. Which method of instruction was preferred by teachers and for what reasons?

Two approaches to the utilization of a weekly news magazine were prescribed. They were termed the limited systematic approach, method A, and the supplemental systematic approach, method B. The limited systematic approach was characterized by intensive use of the news magazine alone. The supplemental systematic approach was characterized by continuing activities provided through suggestions for optional study. Each week a purpose for observing significant current happenings was developed with the pupils. There was a structured attempt to relate each successive current events discussion to the last.

A period of ten weeks was used for experimental instruction. Nine teachers and eighteen sixth grade classes participated in the study. Each teacher received two study guides each week, one for use with each of his classes. One study guide conformed to the prescribed limited systematic approach and the other conformed to the prescribed supplemental systematic approach. All guides were based on the current week's issue of the news magazine. Amount of time devoted to direct instruction was the same for both groups.

Three current events information tests each composed of forty-two items were administered to the subjects. The first came prior to experimental instruction, the second at the end of five weeks of instruction and the third at the close of the instructional period. These were all original instruments.

A ten per cent coefficient of risk was adopted as a standard by which to retain or reject the null hypothesis of mean differences. Analysis of variance was used to analyze the pre-study test scores. The pre-study test results served as the criterion measure. Analysis of co-variance was utilized in analyzing the intermediate and post-study test scores.

A pupil questionnaire administered prior to instruction and readministered at the close of instruction was used to gain additional information. Tape recorded interviews were obtained from eighteen pupils, nine from each method group. These were rated by 22 graduate students from the State University of Iowa. Tape recorded interviews were also obtained with the teachers who provided the experimental instruction.

Within the limitations imposed by the procedures of this study, these conclusions were reached.

1. A statistically significant superiority for one prescribed approach over another was not established.
2. A statistically significant F value on the intermediate test suggested that the systematic supplemental approach may have been superior on a short range basis.
3. Shifts in pupil response patterns between the pre and post-study administration of the questionnaire suggested that a systematic presentation of current events at school, irrespective of approach, can influence the utilization of news media outside school.
4. The statistically significant F value obtained for the means of the subjects ratings on the tape recorded interviews suggest that the systematic supplemental approach may result in greater depth of understanding.
5. From their statements the teacher favored the instructional conditions prescribed by the systematic supplemental approach. Their chief reason was favorable pupil reaction.

Microfilm \$3.05; Xerox \$10.80. 236 pages.

## MANAGEMENT ASPECTS OF THE CURRICULUM IN BASIC NURSING EDUCATION

(L. C. Card No. Mic 60-4931)

Charlotte Seyffer, Ed.D.  
University of Maryland, 1959

Supervisors: Professor Gladys A. Wiggin and  
Professor James A. Van Zwoll

An interpretation of certain management aspects of the curriculum in basic nursing education was made in terms of a management concept developed for use in this study.

An analysis was made of the programs currently in effect in the six schools of nursing in Washington, District of Columbia, including the two schools offering the degree program and the four schools offering the diploma program in nursing. Data were obtained through personal interviews, classroom and clinical field observations, and through analysis of instructional materials. The findings indicate the management purposes and plans of the several courses in the basic curriculum and the extent to which the students in each of the schools meet the management purposes.

The data show that management purposes were formulated for the course in tuberculosis by each of the six schools, for medical-surgical nursing by four schools, and for obstetric nursing by one school. Such purposes were not established for the course in pediatric nursing by any of the six schools participating in the study. The stated management purposes, however, did not indicate the nature and extent of the education which the curriculum actually provided in this area in each of the schools.

The amount of time allocated to management content ranged from 8.8 to 13.0 per cent of the total time allotted to all types of clinical course content in these schools. Larger average allotments were made in the tuberculosis nursing course and in obstetric nursing than were made in medical-surgical nursing and in pediatric nursing.

The types of content provided in each of the schools was found to be similar and included concepts relating to planning, organizing, directing, coordinating and reporting. Concepts pertaining to staffing and budgeting were given only as a part of the medical-surgical nursing course.

The management functions which students have as a part of their clinical learning experience in the hospital units were determined in each school. The findings indicate that the typical student was assigned, in the four clinical fields, to units which had from 19 to 39 patients and which had from 6 to 9 members in the total nursing group of the units. The assignments made to the students in each clinical field included 4 patients, a number which appeared to be related more to the size of the nursing group than to the number of patients on the units. The management functions which were a part of the clinical learning experiences for all students were those of planning, directing, coordinating and reporting. A total of 10 students had experience also in organizing while in charge of units during the evening or night periods.

Management education was an integral part of the clinical nursing courses in each of the six schools of nursing. In addition, a thirty-hour course in the principles of management was given for senior students in one of the schools of nursing.

Microfilm \$2.75; Xerox \$9.45. 210 pages.



THE APPLICATION OF THE  
RULES OF PUNCTUATION IN  
TYPICAL BUSINESS CORRESPONDENCE

(L. C. Card No. Mic 60-5586)

Donald Gilmour Stather, Ed.D.  
Boston University School of Education, 1960

Statement of the Problem

The major purposes of this study were to determine which of the many rules of punctuation are commonly applied in modern business correspondence and to determine the degree of accuracy with which student stenographers punctuate correspondence presented in written form for correction and in oral form for transcription.

Summary of Procedures

1. A list of ninety-nine punctuation rules was prepared as a basis for correspondence analysis.
2. Over 120,000 running words of business correspondence in seventeen business firms were analyzed to record all possible applications of punctuation rules.
3. Punctuation rules and letter types were listed in order of frequency of occurrence.
4. A two-battery punctuation test composed of twelve business letters was prepared.
5. A preliminary test administration was used to determine the Spearman rank-difference reliability coefficient.
6. The test was administered to 400 senior stenographic students, divided into two equal population groups, in fourteen selected public high schools to determine relative performance on written and oral forms. Oral and written techniques of presentation and order of presentation were alternated by battery in administration to the two populations.
7. Means, standard deviations, reliability coefficients (split-test method corrected by the Spearman-Brown prophecy formula), critical ratios of mean score differences, item validity, and item difficulty were calculated on the basis of punctuation test scores.
8. The findings resulting from the application of statistical procedures were analyzed and interpreted.

Summary of Findings

1. Fifty-four of the ninety-nine rules occurred one or more times in the correspondence analyzed.
2. The twenty-seven rules selected for use in the punctuation test represented 97 percent of all punctuation marks used in the correspondence.
3. The Spearman rank-difference correlation coefficient, correlating the scores of thirty students on Battery I, written form, with the scores of the same students on Battery II, written form, was  $+ .89$ .
4. The reliability coefficients obtained by use of the split-test method, corrected by the Spearman-Brown prophecy formula, were  $+ .85$  for the written form of Battery I,  $+ .80$  for the oral form of Battery I,  $+ .88$  for the written form of Battery II, and  $+ .94$  for the oral form of Battery II.
5. Item analysis revealed that sixteen of the twenty-five items in Battery I (64 percent) and seventeen of the

twenty-five items in Battery II (68 percent) met the criterion of discrimination on the total test score at the 1 percent level of significance. The criterion of acceptance or rejection was consistent for similar items in Battery I and Battery II in twenty-four of the twenty-five items.

6. Student scores on the punctuation test ranged from a low of 64 to a high of 119. Maximum possible score on the test was 120.

7. Critical ratios of differences in mean scores were as follows:

- a. Battery I, written form, versus Battery I, oral form: 9.06. Battery II, written form, versus Battery II, oral form: 5.38. Mean scores on written forms of both batteries were significantly higher than on oral forms.
- b. Battery I, written form, presented first, versus Battery II, written form, presented last: 1.68. The difference in mean scores was not significant.
- c. Battery I, oral form, presented first, versus Battery II, oral form, presented last: 4.04. The mean score on the oral form presented last was significantly higher.

8. An item difficulty analysis of the twenty-five test items, using all 400 test papers, revealed a range in percentage of items correctly handled from 100 percent to 22.72 percent.

Conclusions and Recommendations

1. Approximately half of the commonly recognized rules of punctuation are used in modern business correspondence. Approximately one quarter are in common use.
2. Students did not have as much success in punctuating when transcribing from shorthand (oral form) as they had when punctuating written material presented for correction (written form).
3. Order of presentation of written and oral forms of the test was a significant factor. Students performed better on the orally dictated form when it followed the written form.
4. The punctuation test prepared in this study is useful as a diagnostic test and as an achievement test.
5. Teachers in schools, in colleges, and in business, and authors of instructional materials may use the findings of this study to improve the training of office workers in the punctuating of business correspondence.

Microfilm \$2.70; Xerox \$9.45. 208 pages.

**A STUDY OF THE INSTRUCTIONAL  
COMMUNICATIVE RESOURCES EMPLOYED  
IN SELECTED BASIC COURSES  
OFFERED AT INSTITUTIONS  
OF HIGHER EDUCATION**

(L. C. Card No. Mic 60-5581)

Robert Earl Stepp, Ph.D.  
The University of Nebraska, 1960

Adviser: Merle A. Stoneman

This study was designed to determine the extent to which instructional communicative resources were being utilized in teaching selected freshman-sophomore courses and the trend of professional thinking concerning the inclusion and employment of these resources in future instruction. Three hundred and sixty faculty members in twelve midwestern universities participated in the study. The respondents, representing all instructional ranks, were selected because of the specific course that they were teaching and not because of their knowledge about or previous experience in utilizing instructional materials in their teaching. The survey included forty-nine subject areas in the College of Agriculture, Arts and Sciences, Business Administration, Education, and Engineering.

The purpose of the study was four-fold: (1) to survey the instructional communicative resources being used in selected freshman-sophomore courses and to analyze this data according to preference in five forms of teaching presentations, (2) to determine the types of instructional resources that college and university instructors teaching these courses believe will increase and extend their teaching effectiveness, (3) to study the supporting role of the audio-visual center for the provision of these resources to the academic faculty, and (4) to make recommendations for provision of these resources at the University of Nebraska.

The procedure was to tabulate the responses of participants according to the frequency of use for five types of instructional patterns: (1) seminar, (2) lecture, (3) lecture-recitation, (4) lecture-demonstration, and (5) lecture-laboratory. A weighted value was assigned to each response and from these data an average frequency index was computed. This computation was made for present use of materials, ideal use of materials now available, and ideal use of materials not now available. The t-test of difference was employed for the statistical analysis. Related information, pertinent to the utilization of these resources, was also gathered from the instructors and the audio-visual directors in each institution.

The general conclusions are:

1. An analysis of preferences among instructional materials revealed major reliance by these participants on the traditional teaching resources, but with an indication of a strong desire for greater use of a variety of instructional materials by many instructors.
2. Nearly every type of material was identified by some instructors as being indispensable to their teaching and as receiving almost daily use.
3. For some types of materials, as many as one-third of the population in this study indicated that the

materials were not applicable to their subject nor to their method of teaching.

4. The greatest contribution that these materials made to teaching was identified as being to "clarify concepts."
5. Frequency of use of these materials varied from "almost daily use" to "no use," with a majority of the responses indicating selected, occasional use.
6. The greatest potential use of a variety of instructional materials was foreseen in the methods of instruction which utilized demonstration and laboratory techniques.
7. The two most frequently cited deterrents to the use of a variety of materials in teaching were the limited time available for the instructors to locate or design appropriate materials and the non-suitability of certain categories of available materials for teaching these selected courses.
8. A majority of the classrooms in which these courses were taught were reported to be inadequate for the use of a variety of materials in teaching.
9. The need for trained personnel to assist in the preparation of graphic materials for use in teaching these college courses was strongly indicated.

Microfilm \$5.55; Xerox \$19.60. 433 pages.

**THE CURRICULUM INTEGRATION CONCEPT  
APPLIED IN PRIMARY GRADES**

(L. C. Card No. Mic 60-4577)

John Earl Suttle, Ed.D.  
The University of Texas, 1960

Supervising Professor: Dr. Henry J. Otto

The goal of integration has been of great concern to educators during the present century. Confusion and conflict have surrounded its meaning and application. The confusion and conflict arose from three main sources:

(1) failure to identify the referent to which the concept was applied, (2) failure to distinguish means and ends, and (3) differing philosophical and psychological frames of reference of those educators giving expression to the concept. Curriculum integration as conceived in this study assumes significance in terms of the integration of the individual. As such the concept is broader than that usually found in the professional literature. It is more than an amalgamation of subject matter. Curriculum integration was defined as those means and avenues whereby schools may foster integration of the individual.

The underlying purpose of the study was to examine the relationship of curriculum practices found in the primary grades with reference to the integration of the individual. To accomplish this purpose a definitive frame of reference was necessary. Consequently the study fell into two parts. The task of Part I was three-fold: (1) to clarify the meaning of integration of the individual, (2) to explore the concept of curriculum integration, and



(3) to develop a set of guiding principles as they relate to the integration of the individual. Part II entailed the application of the guideposts developed for assaying the nature and scope of curriculum practices in the primary grades of two city school systems. Three sources of data were employed: (1) classroom observations, (2) informal teacher interviews, and (3) curriculum bulletins.

Following an examination of the pertinent literature in psychology and other behavioral sciences, a synthesis of the various related principles and concepts was made. Five major generalized considerations necessary to foster the goal of integration in education were established:

(1) the individual needs to have the opportunity to develop a measure of self understanding; (2) the individual needs to have the opportunity to communicate, to have the feeling that he understands others and is understood by them; (3) the individual needs to have the opportunity to develop a sound and consistent scheme of values; (4) the individual needs to have the opportunity to feel values; and (5) the individual needs to have the opportunity to become goal directed.

Certain broad educational objectives, the nature of specific objectives, curriculum organization, and the characteristics and behavior of the teacher were revealed as factors related to integration. The avenues, procedures, and practices revealed in the curriculum literature were related to the integrative needs of the individual by means of the guidepost framework for examining curriculum integration in practice.

The use of the guideposts in Part II to assay the nature and scope of curriculum integration found in the primary grades of the two city school systems was not an attempt to evaluate the integrativeness of the school systems or classrooms involved, but rather to actually relate the practices observed in the classrooms as well as those recommended in the curriculum bulletins to the integrative needs of the individual.

The findings of the study do not point so much to a change in teaching practices and method as to the importance of educators developing a clear orientation and outlook relative to integration. The curriculum integration concept furnishes the educator with a sound guiding orientation for unifying, relating, and giving direction to his efforts.

Microfilm \$4.85; Xerox \$17.10. 377 pages.

# AN ANALYSIS OF PURPOSES ACCEPTED BY, TEACHING TECHNIQUES USED BY, AND RESOURCES AVAILABLE TO INDUSTRIAL ARTS INSTRUCTORS IN INDIANA HIGH SCHOOLS EMPLOYING ONE INDUSTRIAL ARTS INSTRUCTOR.

(L. C. Card No. Mic 60-6138)

Edgar Stephen Wagner, Ph.D.  
Purdue University, 1960

Major Professor: Frank J. Woerdehoff

## PROBLEM

The central problem of this study is to determine the extent to which industrial arts instructors in one-instructor industrial arts departments in Indiana high schools (1) accept the purposes of industrial arts, (2) use the teaching techniques, and (3) have available the essential facilities and resources which a jury of specialists indicate as desirable criteria for high school departments of industrial arts employing one instructor.

## METHOD

The instrument was prepared by compiling from the industrial arts literature extensive lists of purposes, teaching techniques, and resources. These lists were formed into check-lists which were sent to 82 prospective jurors who were either heads of or ranking professors in industrial arts departments in colleges and universities of the North Central Association of Colleges and Secondary Schools that granted degrees in industrial arts. The jury checked each item on the check-list as to the extent the purposes should be accepted, the extent the teaching techniques should be used, and the extent the resources should be present in a one-instructor industrial arts program.

A second check-list, with items identical to the check-list sent to the jury, was sent to 250 industrial arts instructors who were teaching in high schools that employed only one industrial arts instructor. These instructors checked the items as to the extent they accepted the purposes; the extent they used the teaching techniques; whether or not the resources were present in their schools; and if present, whether the resources were adequate or inadequate for their programs.

Responses were received from 66 jurors and from 147 school instructors. This represented an 80% response from the jurors and 58.8% response from the school instructors.

The data were collected and tabulated. Statistical techniques were employed on those data pertaining to purposes and teaching techniques and a descriptive analysis was made on those data pertaining to resources.

## SUMMARY

The results of Pearson product-moment correlations indicated that on an over-all basis:

1. The school instructors accepted, to a relatively high degree, the purposes that the jury of specialists indicated should be accepted.

2. The school instructors used, to a relatively high degree, the teaching techniques that the jury of specialists indicated should be used.

3. The school instructors who rated high in purposes accepted tended to rate high in teaching techniques used.

4. Schools that had one-instructor industrial arts programs did not have the given physical facilities adequately present to the extent that the jury of specialists indicated that the facilities should be present.

The results of a linear regression statistic indicated that there was a statistically significant relationship at the .05 level of confidence between the extent to which any given purpose was accepted by the school instructors and the extent to which the jury of specialists indicated the purpose should be accepted.

The results of another linear regression statistic indicated that there was a statistically significant relationship at the .05 level of confidence between the extent to which any given teaching technique was used by the school instructors and the extent to which the jury of specialists indicated the technique should be used.

The descriptive analysis of the specific resources indicated that:

1. The larger the school having a one-instructor industrial arts program, the more areas of instruction were represented.

2. Woodworking was represented in 98.6% of the schools participating in this study; drafting, in 95.9%; general metals, in 63.3%; arts and crafts, in 36.1%; electricity, in 30.0%; machine shop, in 19.0%; sheetmetal, in 18.4%; power and transportation, in 9.5%; graphic arts, in 6.1%; and foundry, in 2.7%.

3. Instructional areas other than woodworking and drafting tended to be represented in the larger schools rather than in the smaller schools.

Microfilm \$2.85; Xerox \$9.90. 219 pages.

## THE CURRICULUM INTEGRATION CONCEPT APPLIED IN INTERMEDIATE GRADES

(L. C. Card No. Mic 60-4578)

James Merrett Ward, Ed.D.  
The University of Texas, 1960

Supervisor: Dr. Henry J. Otto

This study developed a theory of curriculum integration for the purpose of examining the nature and scope of curriculum integration in practice. The theory was defined as those avenues and means by which the school seeks to foster the integration of the individual. The guiding principles for the theory as developed were expressed in terms of basic integrative needs of the individual. The individual needs to have the opportunity to: (1) develop a measure of self understanding; (2) communicate, to have the feeling that he understands others and is understood by them; (3) develop a sound and consistent scheme of values; (4) feel valued; and (5) become goal directed. Using the guiding principles as a point of departure and drawing upon general curriculum theory, an outline of framework was developed for the purpose of relating the integrative needs of the individual to the school situation. The framework was then used to examine curriculum integration in a school system context. Observations were made in three fourth, three fifth, and three sixth grade classrooms in each of two city school systems. The data obtained were analyzed in terms of the framework. Rather wide variation in the number of provisions for integrative needs was noted among the classrooms observed. Yet all classrooms made some provisions for the integrative needs. Curriculum guides from the two school systems also were examined via the framework. The guides exemplified extensive provisions for integration. Results seemed to indicate that rather wide variation in method and techniques are possible in terms of fostering integration.

The curriculum integration concept could serve to furnish a set of guiding principles that gives direction, furnishes the orientation for methods and techniques. The framework developed in the study amounts to an exposition of the curriculum integration concept from the level of guiding principles to the level of actual classroom practices.

Microfilm \$4.80; Xerox \$16.90. 374 pages.



## ENGINEERING

### ENGINEERING, GENERAL

#### AN INVESTIGATION OF SOME NUCLEAR PROPERTIES AND APPLICATIONS OF THE RARE GAS CLATHRATE COMPOUNDS

(L. C. Card No. Mic 60-4193)

John Edwin Mock, Ph.D.  
Purdue University, 1960

Major Professor: E. A. Trabant

Because of possible pollution of the atmosphere, a need has arisen for a more satisfactory solution to the problem of containing the reactor off-gases, xenon and krypton. Moreover, investigation and utilization of the many unique properties of the rare-gas nuclides are severely handicapped since these elements are gases under normal conditions. This study was established, therefore, to investigate the possibility of forming useful rare-gas compounds which will exist in the solid state, with emphasis placed upon the clathrate compounds. It is believed that such rare-gas compounds should find use as a temporary (or permanent) storage medium for reactor waste gases, as a convenient form for handling and shipping rare-gas radioisotopes, and as a more satisfactory medium for containing the rare-gas radioisotopes to be used as radiographic and gaging sources of radiation.

Several methods were investigated for preparing the rare-gas clathrates: crystallization from aqueous solutions of quinol, from non-aqueous solutions, from the quinol melt, and directly from the vapor phase. All methods were found to produce clathrate crystals in good yields. Correlations were obtained which outline the optimum operating conditions in each case. In general, high pressures, low quinol concentrations, and slow cooling rates favor the formation of crystals with high rare-gas content. Under identical operating conditions, crystals with much higher gas content are obtained from non-aqueous solutions than from aqueous solutions, and both methods give higher yields than do the solventless techniques. Of the latter techniques, the vapor-phase method was found to be more effective than the crystallization-from-melt method, e.g., at 250 psig the former method yielded crystals containing ten times the amount of gas contained in crystals from the latter method.

Krypton and xenon were found to fill more clathrate vacancies than were filled by argon under identical conditions. Crystals containing 0.12% helium and 0.35% neon were prepared. The high density of these crystals precludes their being beta-quinol clathrates. It is postulated that they are interstitial crystals.

It was found that almost any change to the quinol structure destroys its ability to form a clathrate compound, and that the amino group, either because of weaker hydrogen-bonding tendency or steric hindrance, cannot satisfactorily replace either of the quinol hydroxy groups.

Other six-member ring systems (pyridazine, pyridine and pyrimidine) with para-hydroxy groups were found not to form the clathrate structure, which may be attributed to slight differences in size or configuration of the rings as compared to the benzene ring, or to directive influences of the nitrogen atoms. Of the 21 matrix materials investigated, only p-fluorophenol apparently forms a clathrate compound with the rare gases.

It was discovered that quinol does not form the clathrate structure in acetone solutions due to the preferential formation of a 1:1 acetone-quinol crystalline compound. Similarly, it was found that p,p'-biphenol and acetone also form a unique 1:1 crystalline compound.

A theoretical analysis was made of the thermal stability of the radioactive rare-gas clathrates. Equations were developed to describe the temperature distribution in such slabs for various boundary conditions. A generalized plot was prepared for alpha emitters, and a general analysis based upon diffusion theory was accomplished for beta emitters. It was found that a new dimensionless group  $\left[ \frac{\lambda^2}{a} \right]$  plays a dominant role in heat transfer when radioactive decay is involved. It has been proposed that this quantity be designated the nutherm number because of its fundamental significance.

Various rare-gas clathrate crystals were exposed to gamma radiation and found to be stable to a total dose of  $1.14 \times 10^8$  rads as a minimum (the equivalent of an integrated thermal flux of  $5 \times 10^{17}$  nvt). The only perceptible change due to the radiation was a coloration effect which is apparently electronic in origin.

This study was concluded with a discussion of several possible applications for these unique materials in the field of nuclear technology.

Microfilm \$2.50; Xerox \$8.40. 185 pages.

### ENGINEERING, AERONAUTICAL

#### THE MAGNETO FLUID DYNAMIC PROBLEMS OF STOKES FLOW AND OF HYPERSONIC FLOW AROUND A CONE

(L. C. Card No. Mic 60-4148)

James Robert Barthel, Ph.D.  
Purdue University, 1960

Major Professor: Paul S. Lykoudis

This thesis is divided into two parts, the first of which is a detailed abstract of a paper entitled "The Slow Motion of a Permanently Magnetized Sphere in an Electrically

Conducting Medium," by James R. Barthel and Paul S. Lykoudis. This work appeared as Purdue School of Aeronautical Engineering Report No. A-59-11, August 1959, and will appear in the Journal of Fluid Mechanics. It is concerned with the mathematical solution for the axi-symmetric flow field and magnetic field around a sphere which is permanently and uniformly magnetized in the direction of its motion, and which is moving with a Reynolds Number of order one or less in a fluid which has constant density, viscosity and electrical conductivity.

The velocity, pressure and magnetic field were found by iteration. First the induced currents and ponderomotive forces are computed from the known Stokes velocity field and the known permanent magnetic field and substituted into the equations of motion and Maxwell's Equations. These are then solved for the first approximation to the velocity, pressure and magnetic field distributions. The results are then used to recalculate the induced currents and ponderomotive forces. The process is continued in this way until convergence is evident. No general criterion for convergence was found. However, the increase of the total drag on the sphere over the Stokes drag, as computed by the first iteration, is within  $\epsilon$  per cent of the drag increase computed by the second iteration, if the Hartmann number  $M$  is  $1.87\epsilon$ . A physical argument is given that the actual drag must be somewhere between those computed by the first and second iterations.

Part II is entitled "Hypersonic Flow Around a Cone in the Presence of a Magnetic Field." The work is an analysis of the flow behind a shock attached to a cone. It is known that if the distance over which the magnetic field changes significantly is much greater than the thickness of the shock wave, changes across the shock are independent of the magnetic field. It is shown then that, if the free stream is non conducting and if the shock is attached, its angle of inclination at the vertex of the cone is the same as in the non magnetic case.

The location of the attached shock wave, as a function of radial distance from the vertex, is analyzed in the Newtonian Approximation, in which it is assumed that the density ratio across the shock is very small, and that the shock layer is very thin and contains fluid with constant density and constant electrical conductivity. An expression is found for a generalized shock layer thickness as a function of a variable parameter which is proportional to the distance from the vertex; this expression is the solution of the approximate equation of conservation of mass across the shock. The results of this analysis are shown to compare favorably with the results of a numerical integration of the exact equations, which include variable density and electrical conductivity, in one specific case.

Finally, a conjecture is given on a possible mechanism of detachment of the shock wave by increasing the magnetic field. Microfilm \$2.50; Xerox \$4.20. 76 pages.

## POTENTIAL FLOWS IN THE APPROXIMATION OF VISCOUS ACOUSTICS

(L. C. Card No. Mic 60-6502)

William Joseph Rae, Ph.D.  
Cornell University, 1960

Steady, irrotational flows are studied in a linearized approximation, retaining the effects of dispersion and attenuation due to viscosity in the region outside the boundary layer. The differential equation for the velocity potential in this approximation is derived and discussed, and formal solutions for the flow around non-lifting two-dimensional and axisymmetric bodies are found. Approximate evaluations of the formal solution then reveal that throughout all of the subsonic, and most of the supersonic flow field, the inviscid solution is altered by a correction that is first-order in a viscosity parameter. In the supersonic cases, the familiar inviscid wave pattern tends to be dispersed in the vicinity of the body, and at great distances from the body, all disturbances decay. The rates of decay of pressure disturbances at these distances are found, and their relation to the inviscid, nonlinear treatment of the same problem is discussed.

In the course of the Fourier analysis of the problem, a Fourier transform which is not listed in any of the standard tables is evaluated, and this provides a closed-form solution to a boundary-value problem involving a certain third-order partial differential equation. Both of these results are thought to be new.

Microfilm \$2.50; Xerox \$5.60. 115 pages.

## ENGINEERING, AGRICULTURAL

### TWO-DIMENSIONAL FLOW THROUGH POROUS MEDIA

(L. C. Card No. Mic 60-5874)

Joe Millard Bunn, Ph.D.  
Iowa State University of Science and Technology, 1960

Supervisors: Professor W. V. Hukill and  
Dr. J. J. L. Hinrichsen

An analytical expression to predict air pressure patterns in a porous bed arranged as a non-linear flow system was the objective of the study. Previous investigators only considered specific installations to answer certain questions about these, or in the more general approaches failed to show experimental proof of their analytical work.

The problem was approached by empirically determining a linear flow relation between pressure gradients in, and air flows through beds of steel shot arranged as a linear flow system,

$$\Delta P/L = a(e^{bw^2/\Delta P/L} - 1) \quad (1)$$

where  $\Delta P/L$  is the pressure drop per foot,  $w$  the air flow rate,  $e$  the base of the natural logarithm, and  $a$  and  $b$  empirical parameters. Then from the assumptions that in a non-linear air flow system:



1. air flowed normal to the isopressure surfaces, and
2. the differential form of Equation 1 described the air behavior in the direction normal to the isopressure surfaces, Equation 1 was combined with the two-dimensional steady-state mass continuity equation to obtain,

$$\begin{bmatrix} (1 + M) P_x^2 + 2 P_y^2 \\ 2 P_x^2 + (1 + M) P_y^2 \end{bmatrix} \begin{bmatrix} P_{xx} + 2 (M - 1) P_x P_y P_{xy} + \\ P_{yy} = 0 \end{bmatrix} \quad (2)$$

for predicting pressures in a non-linear flow system. Where

$$M = \frac{\sqrt{P_x^2 + P_y^2}}{\left( a + \sqrt{P_x^2 + P_y^2} \right) \ln \left( \frac{a + \sqrt{P_x^2 + P_y^2}}{a} \right)}, \quad (3)$$

$P_x = \partial P / \partial x$  etc.,  $a$  is as defined above, and  $\ln$  is the natural logarithm. A second pressure prediction equation was obtained from the literature,

$$\begin{bmatrix} (1 - m) P_x^2 + 2 P_y^2 \\ 2 P_x^2 + (1 - m) P_y^2 \end{bmatrix} \begin{bmatrix} P_{xx} - 2 (1 + m) P_x P_y P_{xy} + \\ P_{yy} = 0 \end{bmatrix} \quad (4)$$

where  $m$  is an empirical parameter and the other factors are as defined above. This equation was developed in the same way as Equation 2, except the development started from the linear flow equation,

$$w = C (\Delta P / L)^m \quad (5)$$

where  $C$  is an empirical parameter, and the other factors are as defined above.

Equations 2 and 4 were solved for numerical solutions which were compared to data determined experimentally for air flow through a bed of steel shot held in a model of a duct-type crop drier. From the study it was concluded that Equation 2 predicts pressures to agree with experimentally measured pressures, but Equation 4 does not. Equation 4 fails because it was developed from a linear flow equation which only is applicable for very narrow ranges of air flow rates.

Microfilm \$2.50; Xerox \$6.60. 140 pages.

#### INCIPIENT MOTION OF SOLID PARTICLES IN A TWO-DIMENSIONAL FLOW FIELD

(L. C. Card No. Mic 60-4898)

Connayil Mani Jacob, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: Glenn Murphy

This study is concerned with the determination of the lift acting on a cylindrical solid resting on the bed of an open channel. The lift was determined from observations of the cylinder under the condition of incipient upward motion. Two-dimensional flow was maintained in the portion of the channel where the solid was tested. The lift was studied from the point of view of dimensional analysis

and ten variables, including lift as the dependent variable, were assumed pertinent.

The equipment consisted of an open channel 12 ft. long by 6 in. wide by 15 in. deep, having a smooth bed and in which water was recirculated. A cylindrical solid was placed on the bed of the channel with its axis at right angles to the flow in the channel, and was held in position by two cotton threads tied to two needles that were inserted into the bed. The threads were kept horizontal and symmetrical to the longitudinal axis of the channel, and prevented any motion of the solid except in the vertical direction. At a certain stage of flow in the channel the solid lifted off the bed and started to bounce. This first observable bouncing of the cylinder was taken to be the incipient upward motion of the cylinder. The summation of the forces neglecting acceleration gave the lift, since for this condition the lift is equal to the weight of the solid in water. The error involved in neglecting acceleration was estimated to be about three percent.

Eleven cylinders made of two different materials were tested for incipient upward motion for various depths of flow in the channel. A velocity profile for each of these critical conditions of flow was determined by means of a pitot tube connected to a micromanometer. The results were analyzed on the basis of the mean velocity of flow in the channel and the centroidal velocity, the latter being defined as the velocity at the centroid of the area bounded by the velocity profile curve, the  $y$ -axis, and the line  $y = d$ , where  $y$  is the distance from the bed of the channel and  $d$ , the diameter of the cylinder. The results, although not conclusive, indicate that the centroidal velocity is significant in the phenomenon of lift. It was suggested that the centroidal velocity could replace the mean velocity and depth of flow from the variables listed originally and this possibility was investigated.

The lift determined experimentally was compared with that obtained from an expression developed by H. Jeffreys using potential theory. The measured value of lift was appreciably greater than that obtained from the theoretical expression. The results of the investigation indicate that lift can be determined accurately by the method described and that the lift is a significant force which should not be neglected in the study of sediment transport phenomena.

Microfilm \$2.50; Xerox \$5.00. 100 pages.

#### A SOLAR-POWERED AIR CONDITIONING SYSTEM FOR LIVESTOCK SHELTERS

(L. C. Card No. Mic 60-4223)

Gerald Martin White, Ph.D.

Purdue University, 1960

Major Professor: G. W. Isaacs

The correlation between the need for space-cooling and the availability of solar radiation in certain localities suggests the possible use of solar energy for cooling purposes. This type of cooling would be especially attractive for applications which require cooling principally during periods of high insolation. The purpose of this study was to evaluate the feasibility of using solar energy for one such application, the comfort cooling of livestock shelters.

Analytical and experimental studies have been conducted in carrying out this objective.

A statistical analysis was made to determine the availability of solar radiation for air conditioning purposes in Central Indiana. The need for cooling as indicated by weather records was correlated to the availability of solar radiation as indicated by concurrent solar radiation data. The Temperature-Humidity Index of the United States Weather Bureau was used as an index of comfort. The results of this study are useful as an indication of the frequency of occurrence of selected solar radiation intensities at various times of day and at different levels of comfort.

Different types of solar collectors have been studied with regard to their performance, utility, and cost. On the basis of this comparison the flat-plate solar collector was selected as being the most suitable for air conditioning applications.

In this investigation the solar radiation available at 40 degrees north latitude on a clear May 21 (or July 21) day was designated as that of a typical cooling day in Central Indiana. The performance of a flat-plate solar collector on such a typical day has been computed as a function of its characteristic parameters for noon and for four hours on either side of noon. Computations include collectors with both one and two cover plates.

An experimental lithium bromide water absorption cooling unit has been tested to determine its possible use in solar cooling applications. The results indicate that a coefficient of performance (the ratio of the cooling effect in the evaporator to the heat input to the generator) of 0.5 or better can be expected with such a cooling system as long as the generator input temperature can be maintained above 180 degrees Fahrenheit.

The theoretical performance of a combined solar collection-cooling system has been calculated for a typical cooling day. The system studied consisted of a flat-plate collector, a lithium bromide-water absorption unit, and a solar energy storage tank. The results show the solar energy collection rate, the solar cooling rate, and the quantity of energy in storage at any time during a typical cooling day. In general, it can be stated that the energy storage tank reduces extreme conditions in the collector-generator circuit, delays the time of the maximum rate of cooling, and extends the total length of the solar cooling cycle. The maximum over-all daily cooling efficiency obtained in this study was 26 percent. This efficiency is defined as the ratio of the total daily cooling obtained to the total daily solar energy incident on the collector surface. The above value occurred for a two cover plate arrangement with a fluid flow rate of 10 lb/hr-ft<sup>2</sup>.

Cooling requirements for a specific livestock shelter have been determined based on the heat production of livestock, their ventilation requirements, and assumed environmental conditions. Calculations indicate that a flat-plate collector with an area approximately 50 percent larger than the floor space of the building itself would be required for solar air conditioning. The need for auxiliary cooling has also been evaluated. It is evident that if 24-hour temperature control is desired some means of auxiliary cooling must be provided.

An economic comparison of solar cooling with conventional types of air conditioning indicates that solar energy cannot now compete with conventional fuels insofar as cooling applications are concerned. However, if winter-

time solar space-heating is also considered, the cost of solar energy could be greatly reduced. Under this condition, it could possibly be competitive with conventional fuels in certain localities at the present time.

Microfilm \$2.50; Xerox \$7.00. 148 pages.

## ENGINEERING, CHEMICAL

### NITROSYL CHLORIDE DECOMPOSITION RATES IN SHOCK WAVES

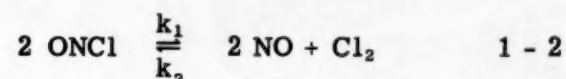
(L. C. Card No. Mic 60-5425)

Bernhard Deklau, Ph.D.

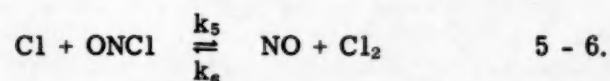
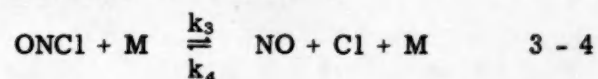
The Pennsylvania State University, 1960

Decomposition rates of nitrosyl chloride were measured from 880°K to 1350°K. The test gas was heated by incident shock waves in a steel shock tube with a 2 by 4 inch cross section. The test chamber was 8 feet and the driver section 4 feet long. Changes in ONCl concentration as a function of time were determined from measurements of light absorption at three wave lengths: 3850 Å, 4360 Å, and 5460 Å. Tungsten filament bulbs served as light sources. Interference filters were used to isolate the desired wave lengths. Outputs from photomultiplier tubes were photographed on oscilloscopes to obtain shock velocities and a record of light intensity change as a function of time. From measured shock velocities and known initial conditions, temperatures and concentrations of heated gases were calculated. Kinetic data were obtained from a total of 53 runs with pure ONCl and ONCl:Ar dilutions of 1:2, 1:5, 1:10, and 1:20.

In the decomposition of pure ONCl at shock temperatures the bimolecular mechanism, which is dominant at low temperatures, makes a small, barely appreciable contribution.



In case of ONCl dilution with Ar this becomes negligible. The most important decomposition path is the unimolecular reaction 3 followed by reaction 5.



The kinetic measurements were made under conditions where contributions from back reactions were insignificant. Compared to reaction 3, reaction 5 is very fast. This results in the establishment, in a time less than 10<sup>-6</sup> sec after reaction begins, of a pseudo-steady state in which the over-all rate is within a few per cent of equaling twice the rate of reaction 3.

The unimolecular reaction 3 was found to be in the second order pressure region. Treatment of the data showed that the first order contribution was not important. A comparison of  $k_{3,M}$  values for M = Ar and



M = ONCl revealed that  $k_{3,Ar}$  is 2 to 3 times larger than  $k_{3,ONCl}$ .

Extrapolations of simple Arrhenius expressions derived from low temperature (523°K and 573°K) data of Ashmore and Spencer (Trans. Faraday Soc. 55, 1868 (1959)) miss the high temperature results by a wide margin and are inadequate. A more satisfactory expression is one of the type derived by considering participation of internal degrees of freedom in the energy transfer process leading to dissociation. Of such theories that of Hinshelwood was chosen. For fitting the results, high temperature data alone could not be used because of scatter. Using Ashmore and Spencer's values for  $k_{3,ONCl}$  and estimating the values for  $k_{3,Ar}$  from their data on diluted runs with CO<sub>2</sub>, the following low temperature-high temperature fit was obtained:

$2 k_{3,Ar} = 2 \cdot 10^{11.16} T^{1/2} [E_0/RT]^{3.43} [1/\Gamma(4.43)] \exp(-E_0/RT)$  cc/mole-sec, where  $E_0 = 37.16$  kcal/mole is the 0°K N-Cl bond energy;  $3.43 = n/2$ , and  $n$  is the effective number of classical square terms from which energy is transferred to the dissociating bond during collision. For pure ONCl the result was

$2 k_{3,ONCl} = 2 \cdot 10^{9.03} T^{1/2} [E_0/RT]^{7.01} [1/\Gamma(8.01)] \exp(-E_0/RT)$  cc/mole-sec.

The result for Ar-dilution cases was quite satisfactory. For pure ONCl, however, a surprisingly low collision efficiency (0.018 per cent) was obtained. It was noted that a similar behavior had been observed in Br<sub>2</sub> dissociation. Consideration was given to some factors which may be important in the dissociation of ONCl and which are not taken into account by the Hinshelwood theory.

Microfilm \$2.50; Xerox \$4.80. 92 pages.

#### REACTION RATES IN AN EXPERIMENTAL RAM-JET COMBUSTOR

(L. C. Card No. Mic 60-5356)

James Merrill Douglas, Ph.D.  
University of Delaware, 1960

Supervisor: Kurt Wohl

A study was conducted on a stoichiometric propane-air flame burning in a duct 2 inches by 1½ inches in cross-section and 20 inches long. The combustible mixture entered the combustor with a velocity of 80 ft./sec. and a low turbulence level. Stabilization of the "two dimensional" flame was achieved by a ¼ inch thick, flat plate which extended across the entire duct width and was placed midway between the top and bottom walls.

Gas samples were removed from the flame at the stream velocity and were analyzed by gas chromatographic techniques. Composition data show that some unburned gases exist at the duct axis even at 20 inches behind the flameholder (0.8 mole percent O<sub>2</sub>). Also, there appears to be a thin layer of completely unburned gas, compressed close to the bottom wall at the duct exit.

Values of the volumetric reaction rates and the effect of turbulent diffusion on the rates were calculated using the procedure developed by Shipman, et.al. (6). The total reaction rates were found to be dependent on the spatial coordinates as well as the fractional completion of com-

bustion. Highest values of the maximum reaction rates were found near the beginning and end of the duct where the concentration gradients normal to the flow direction were the greatest. The values of the maximum reaction rates were in the range of 6 to 14 lb/ft-sec., as compared to a maximum rate of 236 lb/ft-sec. for a laminar flame.

Local values of the turbulent burning velocity were calculated for the entire duct length by dividing the volumetric flow rate (at the approach stream conditions) through a flow tube by the area of the 50% oxygen consumption surface intersecting the flow tube.

Microfilm \$2.50; Xerox \$8.40. 181 pages.

#### THERMAL CONDUCTIVITY OF HETEROGENEOUS MIXTURES

(L. C. Card No. Mic 60-5524)

Robert Lee Hamilton, Ph.D.  
The University of Oklahoma, 1960

Major Professor: O. K. Crosser

The purpose of this thesis was to develop a general equation for the thermal conductivity of binary heterogeneous mixtures consisting of a discontinuous, particulate phase suspended in a continuous phase. The previous theoretical and experimental work indicated several distinguishing features of different types of heterogeneous mixtures and a classification system based on these differences was proposed. From this previous work it was concluded that mixture conductivities could be correlated in terms of the conductivities of the constituents; the volume fraction occupied by the discontinuous phase and the shape of the particles forming the discontinuous phase.

The following equation was developed:

$$K = \frac{K_1 [K_2 + (n-1)K_1 - (n-1)V_2(K_1 - K_2)]}{K_2 + (n-1)K_1 + V_2(K_1 - K_2)}$$

where  $K$ ;  $K_1$  and  $K_2$  are the conductivities of the mixture; the constituent forming the continuous phase and the constituent forming the discontinuous phase, respectively;  $V_2$  is the volume fraction occupied by the discontinuous phase and  $n$  is a constant.

In order to test the equation, measurements were made on greases and mixtures of aluminum particles in rubber and balsa particles in rubber. A new thermal conductivity apparatus was developed to measure the grease conductivities.

The results of these measurements showed that for

$\frac{K_2}{K_1} > 100$ , the constant,  $n$  is  $\frac{3}{\psi}$ , where  $\psi$  is the sphericity of the particles forming the discontinuous phase.

In all other cases,  $n = 3$ .

Microfilm \$2.50; Xerox \$3.80. 66 pages.

# THE ROLE OF THE PACKING IN A SCHEIBEL EXTRACTOR

(L. C. Card No. Mic 60-5881)

John Richard Honekamp, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: Morton W. Smutz

The droplet behavior in Yorkmesh packing was studied with an equilibrated system of methyl iso-butyl ketone and water with the ketone phase dispersed. The drop size and holdup also were measured in a four stage, 3-inch diameter Scheibel extractor with the same liquids. The results of these investigations indicated that the drop size in a Scheibel extractor is determined by the drop size in the mixing sections, and that very little growth in the average drop size occurs in the packing. It was also found that the behavior of the Scheibel extractor at constant stirrer speed with respect to drop size and holdup closely parallels a packed extraction column.

A sampling technique was developed in this investigation to obtain the concentration of both streams at a point inside the extractor. Using this technique the concentration profile along a four stage, 3-inch diameter Scheibel extractor was measured with the system of methyl iso-butyl ketone, acetic acid, and water. From these data the percent of the extraction taking place in the packing was computed.

The performance of the packing in the Scheibel extractor was found to be related to the stirrer speed. This was due to the effects of the stirrer on the transfer area and the concentration gradient in the packed sections. The magnitude of these effects on the over-all efficiency of the packed sections was reported.

Microfilm \$2.50; Xerox \$4.20. 78 pages.

# TRANSFER AND MOVEMENT OF MATERIALS DURING THE RECOVERY OF OIL AND WATER FROM A POROUS MEDIUM BY AN ALCOHOL

(L. C. Card No. Mic 60-5442)

I. S. Krishna Kamath, Ph.D.

The Pennsylvania State University, 1960

An experimental study has been made of the simultaneous displacement, in a linear path, of a hydrocarbon and water by isopropanol in porous media. Two tubes of one inch nominal inside diameter and 5 and 9 feet in length, respectively, were packed with glass beads. Two other tubes of the same diameter and 6 and 10 feet in length, respectively, were packed with crushed Berea sandstone. These four tubes served as the porous media.

The initial saturations were such that one of the phases, oil or water, was immobile under conditions of immiscible displacement. These fluids were displaced downward by isopropanol and a continuous analysis made of the efflux with respect to amounts and compositions of each phase produced. Naphtha was used as the hydrocarbon in most of the runs. However, three oils of higher viscosity were used in some runs.

As expected, the efflux at first (Stage 1) consisted of

only oil or water, since the saturation of the other phase was the minimum required for mobility. Later (Stage 2) a "bank" of pure oil and pure water was produced. The amount of oil or water produced alone before the appearance of the oil-water bank was in accordance with the theory for processes involving recovery of all initial materials, that the oil and water in the bank move with the same linear velocity. Since the saturations in the bank are governed essentially by mobility ratios and not by initial saturations, the total production during which all components appear in the efflux (Stages 3 and 4) should be independent of the initial oil and water saturations if the period required for bank formation could be ignored. This period apparently, can be ignored for the 100 foot core but not for the shorter cores (10 feet or less).

Comparisons have been made between the results of this investigation and other workers with 100 foot cores. The comparison indicates that through-put, in pore volumes during Stages 3 and 4 decreases roughly as the square root of the length, or, is equal to about 2.0-2.5 divided by the square root of the length in feet.

In connection with the efflux analysis it was imperative to have accurate ternary phase diagrams. The use of the tie-line correlation rule of Othmer and Tobias, and a special method of plotting a physical property (such as refractive index) against composition, served as tools in the construction of accurate phase diagrams.

The following conclusions have been drawn from the results of this investigation:

- (1) For isopropanol displacements of oil and water in porous media of the type described, the bank of pure oil and water is formed within a short distance (a few feet) from the injection end of the system.
- (2) The efflux histories for the type of displacement described are qualitatively similar, regardless of the lengths, sand types, and hydrocarbon types, within the limits discussed herein. The similarities lie in the following:
  - (a) Predictability, from viscosity-relative permeability considerations, of oil and water saturations in the bank, and hence predictability of the amount of efflux preceding the appearance of the bank.
  - (b) Cessation of two phase flow after approximately one pore volume of fluid through-put. (Increased oil viscosity tends to increase the through-put to this point).
  - (c) The total through-put, in pore volumes, during which all the three components are produced being, as an approximation, inversely proportional to the square root of the core length.
- (3) The length, on a linear basis, of the three component zone increases roughly as the square root of the distance traveled, during any one displacement process.

Microfilm \$2.50; Xerox \$6.00. 121 pages.



# A STUDY ON MIXING IN A CONTINUOUS FLOW STIRRED VESSEL

(L. C. Card No. Mic 60-3524)

Woong Ki Kang, Ph.D.  
University of Minnesota, 1960

Adviser: Professor W. E. Ranz

A stirred vessel, equipped with a turbine impeller in its center, is maintained in steady state by continuously introducing two miscible liquids. By means of suitable electronic equipment, the temporal concentration fluctuations are measured at several locations in the vessel, i.e. the inlet, the lower feed to the impeller, the flow ejected by impeller, the lower vortexing zone, the upper vortexing zone, and the outlet.

The "goodness of mixing" is expressed by a statistical term, the temporal concentration fluctuation intensity, i.e.

$$I = \frac{\sigma_a^2}{\bar{a}(1 - \bar{a})}$$

The intensity ranges from zero (complete mixing) to unity (complete segregation).

The decay of the intensity in each flow zone, i.e. the inlet zone and the impeller zone, and the over-all mixing performance are studied with parameters of flow rate and impeller speed. The experimental results are in fair agreement with the proposed theories, of which the derivations are strongly based on the nature of the flow pattern in the stirred vessel.

Microfilm \$2.50; Xerox \$6.00. 121 pages.

# TURBULENT MASS TRANSFER AT A SOLID-LIQUID BOUNDARY INSIDE A PIPE

(L. C. Card No. Mic 60-6501)

Che-Yu Li, Ph.D.  
Cornell University, 1960

A small electrode is installed at the wall inside a pipe with water flowing at high Reynolds numbers to measure the concentration fluctuation caused by introducing a tracer solution upstream. From the fluctuation data, the values of the contact times of successive liquid elements can be obtained. It is found that the simplified penetration theory, which considers only those liquid elements which reach the wall, may not be true. A combined film theory and penetration theory model is proposed which is different from the model suggested by Toor and Marchello (A.I.Ch.E., 4, 97, 1958).

Microfilm \$2.50; Xerox \$4.00. 72 pages.

# INTERFACE PHENOMENA DURING GAS-LIQUID MASS TRANSFER OPERATIONS

(L. C. Card No. Mic 60-4678)

John Wallace Mottern, Ph.D.  
The University of Tennessee, 1960

Major Professor: H. F. Johnson

By the use of photographic techniques, the absorption rates of single CO<sub>2</sub> bubbles suspended in downward flowing aqueous monoethanolamine (MEA) solutions were determined for various MEA and CO<sub>2</sub> liquid concentrations. It was found that a linear correlation of the experimental data could be obtained by plotting the mass of the bubble to the one-third power versus absorption time. Such a correlation indicates that the absorption rate per unit area is constant. The absorption rates were found to increase with MEA concentration and to decrease with total absorbed CO<sub>2</sub> concentration (that physically absorbed and chemically combined). However, because of excessive scatter in the experimental data, no satisfactory correlation of the absorption rates with total CO<sub>2</sub> concentrations could be found.

Theoretical analyses of various absorption models were made. Analogue and digital computers were used when the differential equations could not be solved analytically. For two normal MEA it was found that the best explanation of the experimental rate,  $4 \times 10^{-6}$  gm-mole/cm<sup>2</sup>-sec, was given by the model of steady-state diffusion with simultaneous irreversible second order chemical reaction in a stagnant film  $5 \times 10^{-3}$  cm thick. The differential equations involved with this proposed model can best be solved by analogue computer.

In the course of the investigation several absorption models were solved analytically. Although the results indicate that the models did not apply, details of the analyses are given in Appendix A for academic interest. Appendices B and C contain the details of the theoretical analyses by digital and analogue computers.

Microfilm \$2.50; Xerox \$8.40. 183 pages.

# DYNAMICS OF HEAT REMOVAL FROM A JACKETED, AGITATED VESSEL.

(L. C. Card No. Mic 60-5194)

William Samuel Stewart, Ph.D.  
The University of Oklahoma, 1960

Major Professor: Dr. C. M. Sliepcevich

A study was made of the dynamic heat removal from a jacketed, agitated vessel. Heat was removed from the vessel by means of utilizing the heat of vaporization of a liquid boiling in the jacket surrounding the vessel.

From the standpoint of input and output relationships, two different systems were considered. In the first system, the input or forcing variable was the flow rate of the liquid entering the vessel and the output variable was the temperature of the fluid inside the vessel. Both analog computer and experimental studies were made. Frequency response and step response techniques were used. The

differential equation describing the system was solved mathematically for a sinusoidal input. The mathematical solution shows the presence of a DC component and two harmonics in the output. The presence of the DC component and the two harmonics was observed experimentally at low frequencies. At frequencies above 6.28 radians per minute, the DC component and the second harmonic can be neglected. For small disturbances the analog and experimental results showed that the system can be represented by a first order transfer function.

In the second system studied, the input variable was the coolant pressure and the output variable was the temperature of the fluid in the vessel. The pulse response technique was employed in the study of this system. The results showed that the system could be represented by a first order transfer function with pure dead time.

Microfilm \$2.50; Xerox \$7.20. 154 pages.

#### VAPOR PRESSURE AND VAPOR-LIQUID EQUILIBRIUM DATA FOR METHYL ESTERS OF THE COMMON SATURATED NORMAL FATTY ACIDS

(L. C. Card No. Mic 60-4447)

Walter R. Supina, Ph.D.

The Pennsylvania State University, 1960

The object of this study was to determine the vapor-liquid equilibrium relationships for binary mixtures of methyl esters of the common saturated normal fatty acids and to develop a method of predicting these relationships so that a minimum of experimental work would be needed to obtain vapor-liquid equilibrium data for a similar homologous series. Another objective was to resolve certain puzzling difficulties and inconsistencies that had been encountered in previous attempts to obtain such data. The systems examined were methyl caproate-methyl caprylate, methyl caprylate-methyl caprate, methyl caprate-methyl laurate, methyl laurate-methyl myristate, methyl myristate-methyl palmitate, and methyl palmitate-methyl stearate. The system 1-hexanol-1-octanol was also studied to add further information to that available for similar alcohol binary systems. Equilibrium measurements were made at 20, 30, 40, 50, and 100 mm Hg, although not at all these pressures for each system.

The results indicate that the binary mixtures exhibit ideal or nearly ideal behaviour; similar results had been found by other investigators for normal primary alcohol systems and for the caproic acid-caprylic acid binary. The relative volatilities at 30 mm Hg and 0.5 mol fraction of each component in the liquid phase decreased from 5.4 for the methyl caproate-methyl caprylate binary to 2.3 for the methyl palmitate-methyl stearate mixture. The logarithm of the relative volatility was found to be a nearly linear inverse function of the logarithm of the total pressure at constant liquid composition over the pressure ranges examined.

Earlier data obtained by other investigators for the methyl caproate-methyl caprylate system at 50 mm Hg absolute pressure were thermodynamically inconsistent with values predicted from vapor pressure and boiling point composition data. The results of the present work

were obtained in an apparatus which gave improved contacting of liquid and vapor, resulting in relative volatilities considerably higher than reported by previous investigators. In addition these new equilibrium data were thermodynamically consistent with predicted values.

Vapor pressure-temperature data were also determined for each of the components in the ester mixtures and for 1-hexanol. From these data Antoine constants were computed and temperatures calculated for integral values of vapor pressure. Since vapor pressure data for substances are often needed when few or no direct experimental data are available, reliable methods of prediction in such cases are highly desirable. Two methods from the literature, which required at least one vapor pressure-temperature point be available, were found suitable for use with the compounds considered in this work; values predicted by these methods agreed to within 0.2°C of experimental measurements. A new method has been developed for which no data are required for the substance in question; predictions by this method were accurate to within 2°C for the cases examined.

A correlation between relative volatility and a function of molecular weight in several homologous series of compounds was obtained. From this correlation vapor-liquid equilibrium data were predicted for the methyl palmitate-methyl stearate system. The values were in good agreement with equilibrium data predicted from vapor pressure data which in turn had been predicted.

Microfilm \$2.50; Xerox \$7.20. 152 pages.

#### REVERSE COMBUSTION

(L. C. Card No. Mic 60-5465)

Joseph E. Warren, Ph.D.

The Pennsylvania State University, 1960

This investigation was conducted for the purpose of obtaining a theoretical description of the reverse combustion process as it applies to tar sands, determining the extent to which this theory can account for experimental observations and estimating the primary behavior characteristics of the process.

Since it was not possible to include all features of the physical processes visualized as occurring during reverse combustion, the mathematical formulation was based on a highly idealized physical system. This simplified model was developed to include the simultaneous transfer of mass and heat, accompanied by a chemical reaction, in a linear, adiabatic porous medium; the reaction rate function was of the concentration-dependent, Arrhenius type. The behavior of the model was governed by a pair of coupled non-linear differential equations similar to those which have been studied in the field of flame propagation.

The equations that described the quasi-steady state temperature and concentration distributions were solved approximately by making either physical or mathematical simplifications. In either case, the solution was overly determined by the physical boundary conditions so that it was necessary to find a particular value of an arbitrary parameter that caused the additional condition to be satisfied. It was shown that the reverse combustion process could be mechanistically described by physical models



whose behavior equations were solved formally. Furthermore, it was demonstrated that the general reverse combustion equations, as derived, were subject to numerical solution, within the error limits of the experimental data. The effect of heat loss on the behavior of the system was considered in a qualitative sense, and its importance was indicated.

The agreement between experimental data obtained from Athabasca tar sand and the digitally computed results for the same conditions was good enough to validate the theoretical description of the combustion process. A simplified procedure for predicting the behavior was presented; however, reasonable agreement was obtained only when heat losses were considered.

It was emphasized that it was not possible to extend the present theory because of the lack of an adequate chemical-kinetic theory. The principal contribution of this study was that it provided a starting point for the development of a more comprehensive theory.

Microfilm \$2.50; Xerox \$7.00. 150 pages.

## ENGINEERING, CIVIL

### COMPRESSIBILITY OF ARTIFICIALLY SEDIMENTED CLAYS

(L. C. Card No. Mic 60-6090)

Adolph George Altschaeffl, Ph.D.  
Purdue University, 1960

Major Professor: Gerald A. Leonards

This investigation attempts to clarify the suitability of laboratory consolidation testing for ascertaining the in-situ compressibility of natural clay sediments. It comprises the study of effects of stress history, rate of loading, and sampling on the compressibility of artificially sedimented clays.

A residual clay soil derived from limestone was disaggregated and sedimented in the laboratory in a special apparatus. Continuous loadings were applied to the sediments at rates varying from 0.01 to 0.0001 kg./sq.cm./day. A steel frame 9 ft by 6 ft by 16 ft was constructed to permit sedimentation of eight samples simultaneously. The soil was sedimented in special lucite tube-brass (or lucite) base assemblies of two types: a flat base to facilitate sediment sampling and a depressed center base to permit in-place tests.

Various combinations of continuous loading, secondary compression, continuous rebound, and continuous reloading were applied to seven sediments, after which increment type tests were performed, either in-place or on sampled specimens, using conventional or reduced load increment ratios.

The principal conclusions are:

1) A "quasi-preconsolidation pressure" develops in natural clay sediments due to sustained loads from the weight of overburden even if no other changes in environmental conditions take place.

2) Reduced load increment tests produce compression

curves similar to those produced by continuous loading at approximately the same rate.

3) A change in the rate of continuous loading produces a change in the sedimentation-compression curve.

4) The effects of stress release during sampling may not be as significant as previously conjectured. The sampling procedures used in this study appear to have little influence on compressibility other than reducing slightly the magnitude of the deduced quasi-preconsolidation pressure.

Microfilm \$2.50; Xerox \$4.00. 75 pages.

### TIME-DEPENDENT EFFECTS IN NON-COMPOSITE AND COMPOSITE PRESTRESSED CONCRETE BEAMS

(L. C. Card No. Mic 60-5129)

Dan Earle Branson, Ph.D.  
The University of Florida, 1960

This investigation included the analytical and experimental studies of the time-dependent effects on camber deformation, beam stiffness, and differential shrinkage in prestressed concrete members using ten post-tensioned non-composite beams and five composite beams. The studies were undertaken with regard to the effects of different prestress levels (relative magnitude of the prestress force), concrete strength, surrounding moisture conditions, and different time periods between the casting dates for the two concretes of the composite beam.

The objectives of the investigation were: (1) to examine experimentally the initial-plus-time-dependent camber deformation in both non-composite and composite beams and to present methods for determining these deformations relative to certain properties of the concrete and to time; (2) to determine experimentally the effects of different prestress magnitudes and concrete aging on the elastic properties of both non-composite and composite beams; (3) to determine the range of effects to be expected from differential shrinkage in composite prestressed concrete construction and to present a simple method for calculating differential shrinkage stresses for given design conditions.

Total camber deformation was found to vary closely with prestress level (relative to concrete strength) but to be relatively insensitive to different concrete strengths and atmospheric conditions. The analytical methods set forth for predicting camber deformation in both non-composite and composite beams were found to be in good agreement with the test results. The necessary concrete coefficients for the analysis of total camber were experimentally determined and ultimate values were recommended for design purposes.

For ordinary prestress levels, the effective moduli of elasticity of prestressed concrete beams under instantaneous loading were found to increase about 30% (to  $E = 5.5 \times 10^6$  p.s.i.) above the 28 day cylinder moduli ( $E = 4.25 \times 10^6$  p.s.i.) after 208 days following prestressing. The beams were prestressed at age 28 days. About 17% of this increase was due to the aging of the concrete and the remainder to the effect of the sustained prestress force. Different prestress levels were found to have a relatively small effect on the percentage increase in the beam moduli

with time, although they did affect the initial increase in stiffness following prestressing.

The effects of differential shrinkage in composite construction were found to be significant, particularly in relatively low humidity regions. A simple analytical method was presented for the calculation of differential shrinkage stresses. Values were given for the necessary differential shrinkage coefficient covering a wide range of the principal variables, which were found to be relative humidity and the time period between the casting of the two concretes in the composite beam.

Microfilm \$2.50; Xerox \$8.80. 191 pages.

#### SALT INTRUSION INTO COASTAL AQUIFERS

(L. C. Card No. Mic 60-5830)

Harold R. Henry, Ph.D.  
Columbia University, 1960

The problem of salt intrusion is considered for the case of a confined aquifer in which there is a steady seaward flow of fresh water. It is assumed that the aquifer is isotropic and that the flow is two-dimensional.

The problem is first solved for the limiting case of zero dispersion in which case a distinct interface exists, separating the fresh water from the salt water. A hodograph method and conformal mapping yield solutions for the location of the interface for several sets of boundary conditions. The mathematical problem for certain of these boundary conditions is similar to the problem of gravity seepage through dams for which solutions already exist. Numerical results are presented for semi-infinite aquifers with vertical and horizontal outflow faces and for several cases of finite aquifers. In the cases for which the length of intrusion is many times the depth, the location of the interface, except near the ocean can be approximated by using a Dupuit type assumption.

The problem is next solved taking into account dispersion or diffusion of the salt component. In this case the governing equations are Darcy's law, the continuity equations for water and for salt and a dispersion or diffusion law. In terms of a stream function  $\psi$  and the salt concentration  $C$  these equations reduce to two second order partial differential equations one of which is non-linear.

The dimensionless flow and concentration patterns are the same for all cases which are geometrically similar and have the same values of the two dimensionless parameters  $Q/dk_1$  and  $D/Q$  where  $k_1$  is the product of the aquifer transmission coefficient and the ratio of the density difference to the density of the fresh water,  $d$  the depth of the aquifer,  $Q$  the fresh water discharge, and  $D$  the dispersion coefficient.

The effect of oscillatory motion induced by tides which produces a large effective dispersion coefficient is discussed.

The non-linear equations governing the problem including dispersion are reduced to an infinite set of non-linear algebraic equations by use of Fourier series representations of  $\psi$  and  $C$  and subsequent application of Galerkin's method to derive equations for the Fourier coefficients. Truncated sets of these algebraic equations are solved by an iterative scheme and numerical values

of  $\psi$  and  $C$  presented for two specific cases. These are compared with the limiting case of zero diffusion, which is the case with a distinct interface. The other extreme of diffusion with no density difference, also is presented for comparison.

Microfilm \$2.50; Xerox \$3.00. 60 pages.

#### THE MECHANISMS OF AIR ENTRAINMENT IN MORTARS

(L. C. Card No. Mic 60-6119)

Kenneth Robert Lauer, Ph.D.  
Purdue University, 1960

Major Professor: William L. Dolch

The purpose of this investigation was to develop and test a hypothesis explaining some of the mechanisms involved in air-entrainment in portland cement pastes and mortars by surface-active materials. A survey of the literature indicated that three retention mechanisms had been considered. These were adherence by bonding to solid surfaces, entrapment by aggregate, and viscosity of paste.

Air-entrainment involves both the generation of air in a mix and the various retention mechanisms. A high speed machine mixing procedure was devised which developed maximum air contents, at least at the lower surfactant concentrations in the mixing water.

The concentration of the agent in the aqueous phase of mortars was found to be more significant with regard to the air entrained than the concentration in the mixing water. The surface tension-concentration relationship for the agent in the mortar filtrate was found to be an appropriate analytical tool for the determination of these concentrations.

Several surface-active agents of each type were evaluated at different concentrations in the mixing water. The air content, viscosity of the mortar, concentration of the agent in the filtrate, and the foaming capacity of the filtrate were determined. The importance of mix proportions was shown by changing the water-cement ratio, aggregate-cement ratio, and aggregate size with representative agents. Various substitutes for the cement and aggregate were used to help develop a hypothesis regarding solid-air attachment as a mechanism in air-entrainment.

All classes of amphipathic, relatively low molecular weight compounds entrain air in portland cement mortars. The characteristics of the air system in the mortar depend on the type of agent used, its concentration, and the mixing process. For the compounds tested, the indication is that the fineness of the bubble system in hardened mortars is that with anionics > cationics > nonionics.

The relationship between the total air content in a plastic mortar and the amount of air-entraining agent in the mix is, for many agents, parabolic over portions of the range of air contents.

For air to be generated in the mortar, some surfactant must remain in solution. For the lower air contents there is a linear relationship between the air content of the mortar and the concentration of the agent in the filtrate from the mortar.



The formation of micelles does not affect the air-entrainment process.

The surface characteristics of the solids affect the air-entrainment process. Both coarse and fine fractions are important in spite of the small fraction of the solid surfaces contributed by the coarse component. This influence may be due to the attachment of bubbles to the solids by means of linkages of surfactant molecules. If this mechanism is correct, surface characteristics that promote adsorption of the surfactant molecules with orientation of their hydrophobic portions away from the solid surface will tend to increase the air content and vice versa.

The differences in mineralogical composition associated with hydrophilic aggregates (limestone, quartz, and natural sand) have little effect on the air entrained in a mortar.

Impurities in air-entraining agents may affect the bubble system by means of the formation of composite films.

Surfactant molecules in which the ionic group is flanked by hydrophobic groups are relatively poor air-entraining agents but frequently good wetting agents.

Microfilm \$2.50; Xerox \$5.80. 116 pages.

#### FORCED VIBRATION OF CONTINUOUS HIGHWAY BRIDGES

(L. C. Card No. Mic 60-4900)

Don Albert Linger, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: C. L. Hulsbos

This study presents the application of forced vibration theory to the dynamic problem of multiple axle vehicles traversing continuous highway bridges. An evaluation of this theory is obtained by field testing a simple span highway bridge and three continuous highway bridges. The theoretical work presented includes the determination of the natural frequencies of those continuous structures studied experimentally, and a general application of the theory to other continuous structures. The effect of the mass of the vehicle is considered and the change in the natural frequency due to the mass of the vehicles is obtained. An exact solution is presented for the forced vibration of continuous highway bridges due to the assumed forcing function of the vehicles. In the experimental work the impact was determined at the center line of the single span highway bridge and in the outer and inner spans and at the interior supports for the three types of continuous four span highway bridges. The effect of the vehicle is assumed to be an oscillating forcing function whose frequency is the frequency of axle repetition and whose force is the oscillating load effect of a constant force traversing a beam. The correlation of the theoretical and experimental impact indicates that the simplifications made in the effect of the vehicles are justified for the bridges tested and the experimental vehicle velocities used. These results show qualitatively that the amount of impact is a function of the ratio of the frequency of axle repetition to the loaded natural frequency of the structure.

Microfilm \$2.50; Xerox \$7.00. 147 pages.

#### ANALYSIS OF STEADY AND NON-STEADY FLOW TOWARD AN UNCONFINED WELL

(L. C. Card No. Mic 60-4584)

Harry Huan-Yen Loo, Ph.D.

Utah State University, 1960

Major Professor: Dr. V. E. Hansen

A modified equation for steady flow toward an unconfined well is derived without Dupuit's assumption of horizontal flow,

$$Q = 2\pi K r h \frac{dh}{dr} \frac{1}{1 + c^2 \left(\frac{dh}{dr}\right)^2}$$

in which  $Q$  = pumping discharge,  $K$  = permeability,  $r$  = radial distance from the pumped well,  $h$  = depth of flow at radial distance  $r$  and  $c$  = proportional constant.

Dupuit's differential equation is solved with corrected boundary conditions,  $h = h_s$  as  $r = r_w$ , which results in

$$h^2 - h_s^2 = \frac{Q}{\pi K} \ln \frac{r}{r_w}$$

where  $h_s$  = elevation of seepage face and  $r_w$  = radius of well.

An equation for non-steady flow is also derived with the assumption of horizontal flow under ideal conditions. The equation deduced is

$$h_e^2 - h_s^2 = 1.22 \frac{Q}{\pi K} \log_{10} \frac{3.57 K t h_s}{S r_w^2}$$

in which  $h_e$  = depth of water in well prior to pumping,  $t$  = time and  $S$  = specific yield.

All the above equations are evaluated and checked by using field data. Although the first equation has more theoretical basis than the second, the free surface profiles obtained from both equations under the same field condition are about the same.

The validity of the third equation for an unconfined well is tested for sloping water tables. The conclusion is that this equation applies best during early stage of pumping. Microfilm \$2.50; Xerox \$3.00. 59 pages.

#### STRENGTH AND VOLUME CHANGE CHARACTERISTICS OF A BITUMINOUS MIXTURE UNDER TRIAXIAL TESTING

(L. C. Card No. Mic 60-6131)

James Hamilton Schaub, Ph.D.

Purdue University, 1960

Major Professor: William H. Goetz

A laboratory study was performed upon a bituminous mixture using the constant-lateral-pressure triaxial test and incremental static loading. The study was initiated to establish whether or not bituminous mixtures changed volume during testing and, if so, the magnitude of the changes and their relationship to strength. The effect of various conditions of drainage permitted during a test upon observed strength values was established.

The study was accomplished using a mixture composed

of a constant aggregate gradation and varying quantities of a single bituminous cement. The mixture was compacted into specimens having uniform density and asphalt content throughout the specimen by the use of the kneading compactor.

Equipment was developed to permit measurement of the changes of volume of a specimen subjected to triaxial loading during the performance of a test. The equipment measured the change in volume of the triaxial cell liquid which reflected changes in the volume of the test specimen.

The stress-strain and volume change characteristics of sixty-five specimens were established. All tests were conducted at confining pressures of 15, 30, or 60 psi and axial loads were applied through a lever system.

The results show conclusively, for the particular mixtures and procedures used, that bituminous mixture specimens change volume during the performance of a triaxial test. All specimens tested showed a slight decrease in volume followed by an increase in volume to failure. The volume increase was linear with axial strain from a strain corresponding to approximately minimum volume to failure. The results of the volume change studies indicated that dilatancy occurs in bituminous mixtures in much the same fashion as in dense granular soils.

Volume changes were analyzed in terms of the changes of percent voids and void ratios of the specimens. For the bituminous mixtures tested, a relationship between void ratio and percent voids of a specimen, at two percent strain and at the Proportional Limit, and the deviator stress at these points was established. This relationship was found to be linear between void ratio or percent voids (arithmetic scale) and deviator stress (logarithmic scale) and was dependent upon the initial void characteristics of the specimen. The relationship was apparently independent of confining pressure. To verify the unique character of the voids--deviator stress relationship, specimens were compacted to a given set of initial conditions and these conditions changed by water-saturation of the specimens prior to testing.

It was established, for the mixtures and procedures used, that the drainage conditions existing during a test had no measurable effect on the magnitude of observed shear strength values. Indirect evidence did indicate, however, that negative pore pressures developed during testing. As the negative pore pressures did not affect the observed strength results, it was concluded that the effect of these pressures was so small as to be masked by the high strength values of the mixtures tested.

The effect of asphalt content and compaction pressure on the value of apparent cohesion and apparent angle of internal friction was investigated. The results clearly indicate that both of the apparent strength parameters were affected not only by asphalt content but by compaction pressure as well.

Results show that the aggregate density variation of the mixture used provided a fairly good measure of the relative values of observed compressive strengths while bulk density did not.

Data were gathered on the effect of asphalt content and compaction pressure upon the Modulus of Deformation of the mixtures studied. In general, it was established that the Modulus of Deformation was affected greatly by asphalt content at high compaction pressures but only slightly at low compaction pressures.

A limited study of the Deformation Ratio of the par-

ticular bituminous mixture used was accomplished. Deformation Ratio was defined as the ratio of lateral strain to axial strain and is analogous to Poisson's Ratio for elastic materials. The results of the study indicate that the Deformation Ratio varies from values of less than 0.5 to nearly 1.0 during a test. Further, it was shown that the apparent angle of shearing resistance was mobilized gradually with a continuing increase in Deformation Ratio to a point at which the maximum apparent angle of shearing resistance was developed. The maximum apparent angle of shearing resistance established by the Deformation Ratio studies compared favorably with the same measure determined by the Mohr circle analysis of stress at failure. Microfilm \$2.55; Xerox \$8.80. 194 pages.

## ENGINEERING, ELECTRICAL

### APPLICATION OF TOPOLOGY TO NETWORK ANALYSIS

(L. C. Card No. Mic 60-6097)

Garland Edward Ching, Ph.D.  
Purdue University, 1960

Major Professor: George R. Cooper

The typical problem in electrical networks is one of determining the performance of the network. For an extensive network the conventional analytical work will be so complicated that an insurmountable amount of labor and time is required. Hence, the application of digital computers to the solution of network problems becomes indispensable. In order to facilitate the solution on the computer, the topological treatment of networks may be introduced.

The network problem will be solved if the network parameters (driving-point and transfer admittances or impedances) are all found. A network may be considered as an oriented graph. Since the network parameters are completely characterized by the topological structure of the network, it is plausible to determine these parameters by investigating the topological properties of a linear graph. Many intuitive methods have been developed but few are suitable for computer programming. In this dissertation these network parameters are determined in a logical manner in terms of the incidence relations between nodes and branches. These incidence relations may be represented uniquely by a matrix which can be stored in the computer. Furthermore, the computations may be performed step by step by selecting a tree and the solution can be carried out on the computer with facility.

The network parameters may be tabulated in a matrix whose elements are dependent on the selection of independent variables (voltages or currents or both) for a particular problem. Three types of parameter matrices (admittance, impedance and hybrid matrices) are discussed in this presentation. For a complicated network the determination of these parameter matrices may be simplified by splitting the network into an appropriate number of simpler subnetworks. The parameter matrices



of each subnetwork may be determined separately and then interconnected to form the parameter matrix of the whole network.

Since the network problem has a unique solution, after any type of parameter matrix for a certain basis has been found all other parameter matrices can be determined by a transformation. However, the determination of each type of these parameter matrices in terms of incidence matrices is presented here.

Microfilm \$2.50; Xerox \$8.00. 171 pages.

#### VAN DE GRAAFF TO PURDUE SYNCHROTRON ELECTRON OPTICS

(L. C. Card No. Mic 60-6102)

Richard Francis Donovan, Ph.D.  
Purdue University, 1960

Major Professor: W. M. Hesselberth

The design, construction, and preliminary testing of an electron-optical system for the new 1 Mev Van de Graaff electron injector for the Purdue synchrotron is discussed. The new features of this system are a magnetic shielded inflector and an off-axis injection system.

Acceptance studies for the Purdue synchrotron showed not only that the allowable  $x$  and  $z$  divergence limits are respectively twelve and six milliradians for a one centimeter beam spot size in an off-axis injection system, but also that off-axis injection systems generally gave greater elapsed time before the first loss or eighty percent loss of the injected beam occurred for the operating "n" values.

Since calculations show that the ion build-up time is about 1.08 milliseconds, space charge neutralization is probably not important during early injection stages.

Relativistically correct electron-optical equations for beam-spreading and magnetic focusing are derived. 1 Mev electron beam spreading curves for  $r'_0 = 0.000, .001, .002, .003$ , and  $-.001$  radians are given for an initial one centimeter beam spot size.

Magnetic characteristics of the injection path and the magnetic shielded inflector are discussed.

Design equations for Helmholtz-like coil-pairs used for steering and translating 1 Mev electron beams are also given. Microfilm \$2.50; Xerox \$6.20. 127 pages.

#### THE EFFECT OF TRANSPORTATION-TYPE TIME LAGS IN THE ADAPTIVE LOOP ON THE DYNAMIC PERFORMANCE OF A CONTROL SYSTEM

(L. C. Card No. Mic 60-6498)

Louis Joseph Galbiati, Jr., Ph.D.  
Cornell University, 1960

A study of the effect of adaptive loop transportation-type time lags on the dynamic performance of a control system is presented in this dissertation. The condition imposed upon the control system under study is that the

damping of a pair of lightly damped complex roots be maintained between prescribed limits. The adaptive compensation is in the form of a stepwise variation or a continuous variation of the gain and the time constant of some part of the main control system.

The root locus approach is used in finding a solution to the problem since the adaptive criteria are expressed in terms of the dynamic response of the system.

The case of a very simple open adaptive loop system where the environment only affects the time constant of one block of the system and the adaptive compensation is in the form of a stepwise variation of the time constant of a different block of the system is considered first. A method of determining the effect of the adaptive loop transportation-type time lag is developed. This method is extended to more complex open loop adaptive systems where the environment affects both the gain and a time constant of the system and the compensation is in the form of a discrete stepwise variation or a continuous variation in the gain and in the time constant of an element in the main loop of the system.

The case of a system having a closed adaptive loop is considered, and it is shown that the effect of the adaptive loop time lag can be determined by considering an equivalent open loop adaptive control system and using the methods previously developed.

The method utilizes the root locus of the system which has the environment factor as a parameter along the curve. A method of determining the shape of the locus is illustrated for the different cases considered.

The results of the analytical study are verified by designing and assembling a process adaptive control system having an adaptive loop time lag. The performance of the physical system is measured under actual operating conditions to determine the effect of the adaptive loop time lags. The measured results are in good agreement with the predicted effects.

Microfilm \$2.50; Xerox \$6.80. 141 pages.

#### COMMUNICATION OVER CHANNELS THE TERMINALS OF WHICH ARE IN RELATIVE MOTION WITH RESPECT TO EACH OTHER

(L. C. Card No. Mic 60-6506)

John George Lawton, Ph.D.  
Cornell University, 1960

The mathematical theory of communication is reviewed and then applied to channels the terminals of which are in relative motion with respect to each other. Channel capacity is defined as the maximum time rate of transfer of information of which the channel is capable. It is found that the rate of transfer of information, in general, and the channel capacity in particular, are subject to the Doppler shift. When the relative velocity of the terminals approaches the speed of light, relativistic corrections must be applied. The special theory of relativity is reviewed using four dimensional tensor notation. The behavior of antenna characteristics and thermal radiation under a

Lorentz transformation is examined in detail. The effects of the transformation on the channel capacity for fixed co-moving characteristics (e.g., characteristics as measured by an observer at rest with respect to the moving terminal) are illustrated by means of examples. The theory is applied to the "primordial explosion" model of cosmology. The relationship between Hubble's constant and the age of the universe is derived.

The appendices contain fairly extensive tables and charts for the conversion of physical quantities in the special theory of relativity.

Microfilm \$2.50; Xerox \$7.80. 167 pages.

#### IRREVERSIBLE FLUX CHANGES IN 50% Ni-Fe TAPE CORES

(L. C. Card No. Mic 60-4185)

Igor Paul Leliakov, Ph.D.  
Purdue University, 1960

Major Professor: F. J. Friedlaender

A model describing the process of flux reversal in grain-oriented materials is developed, which is applicable to practical engineering problems.

Partial results obtained by previous investigators are used to develop a more precise description of the process. Flux reversal is considered to start with the growth of surface domains of reverse magnetization. The growth of magnetic domains is treated analytically with the assumption that the motion of domain walls will occur for field intensities higher than the coercive force of the material. Wall motion is assumed to be impeded by eddy currents and an equivalent linear damping term representing several physical effects.

The flux reversal process is treated mathematically primarily for the case of a step of magnetomotive force applied to a core with known initial conditions. An analytical relationship between the rate of change of flux and the applied field intensity is obtained, which is found to give accurate predictions of the experimentally observed core behavior over a wide range of field intensities. A general method for the evaluation of core parameters influencing wall motion is presented, allowing the extension of the flux reversal model to grain-oriented materials other than the 50% Ni-Fe alloys treated in this work.

The application of the flux reversal model to describe dynamic core behavior for driving functions other than step fields is formulated mathematically.

Critical remarks concerning the limitations of the approach used as well as suggestions for further refinement of the quantitative model are given.

Microfilm \$2.50; Xerox \$6.20. 127 pages.

#### A STUDY OF APPLIED TENSION AS A CONTROL PARAMETER IN THE ROLLING OF METAL STRIP

(L. C. Card No. Mic 60-6527)

Robert Leroy Mertz, Ph.D.  
The University of Wisconsin, 1960

Supervisor: Professor Harold A. Peterson

The general aim of this research was to evaluate as completely as possible in quantitative terms the parameters of importance in the regulation of thickness of rolled metal strip. Early investigation of the literature made evident the fact that all too little was known of the characteristics of the rolling process itself, the "rolling process" being defined as the relations among properties of the metals being rolled, conditions of lubrication and speed of rolling, and externally applied roll forces and strip tensions. The quantitative consideration of any control scheme required more specific information than could be gleaned from any published data, the work by Hesselberg and Sims<sup>1</sup> being the only set of experimental data to include tension effects.

The fact that strip tensions affect the thickness of rolled strip suggested the use of this variable as a control variable to adjust for deviations in strip thickness. Since in the cold rolling of steel the surface finish and cross section shape are also affected by tension, there would be only a range of tensions available for thickness control within which strip of suitable finish and shape could be produced. The thickness correction by tension adjustment could conceivably be effected rapidly within this allowed range, more rapidly, for instance, than a similar thickness correction could be accomplished by screwdown adjustment.

In order to develop an analytical description of strip metal rolling under tension, the principles of rolling are reviewed and an approximate model for the pressure distribution along the arc of contact between roll and strip is postulated. The assumed pressure distribution is a straight-line approximation to the experimentally known "friction hill" distribution and leads to a quite simple expression predicting the dependence of rolling load (roll-separating force) on the square of the difference of front and back tensions and the tensions, themselves. In addition, the conditions for geometric similarity and dimensional consistency are formulated for rolling with tension, and the effects of roll flattening are incorporated by the use of Hitchcock's Formula.

The results of tests of tension rolling as well as detailed descriptions of the tests and equipment are presented in the light of the proposed analytical model, and the partial derivatives of roll force with respect to both tensions are evaluated on this semi-empirical basis. Second order dependence of the rolling load on tension is found to be present and significant, although attempts at the exact measurement of them have not been fully successful. On the basis of the experimental data and the predictions of the approximate model the tension variable is evaluated as an adjustable quantity for the control of strip thickness and found to be suitable from the viewpoint of the range of thickness correction available with a practical range of tension variation.



1. Hesselberg, W. C. F. and R. B. Sims, The Effect of Tension and Roll Force in Cold Strip Rolling, Journal of the Iron and Steel Institute, Vol. 168, pp. 155-164, June, 1951.

Microfilm \$2.50; Xerox \$5.00. 98 pages.

THE SCATTERING OF A PLANE  
ELECTROMAGNETIC WAVE BY  
A FINITE CONE

(L. C. Card No. Mic 60-6129)

Charles Chandler Rogers, Ph.D.  
Purdue University, 1960

Major Professor: F. V. Schultz

This paper treats the solution of the vector Helmholtz equation for the case of a plane electromagnetic wave at 'nose-on' incidence on a perfectly-conducting cone of finite size. The solution presented is exact and in the form of an infinite series of spherical harmonics. The expansion coefficients of the series are determined by a set of an infinite number of equations involving an infinite number of unknowns. A discussion and numerical investigation of the field singularities at the tip and edge of the cone are included, as well as graphs of the associated Legendre functions of non-integral degree,  $P_{\nu}^{\mu}(\cos \theta)$ , and their first derivatives.

Microfilm \$2.50; Xerox \$4.00. 74 pages.

ON THE DETECTION AND ESTIMATION  
PROBLEM FOR MULTIPLE NONSTATIONARY  
RANDOM PROCESSES

(L. C. Card No. Mic 60-5074)

Jack Keil Wolf, Ph.D.  
Princeton University, 1960

Two major problems in the study of statistical communication theory are the detection and estimation of signals corrupted by additive noise. In this investigation, certain aspects of both problems are examined with particular emphasis on the processing of multiple, non-stationary, time series; i.e., correlated random processes, the statistics of which vary with time.

As a preliminary to this study, some properties of random processes are examined, including an introduction to the concepts of stationarity, uniformity, ergodicity, and time varying power spectra for nonstationary processes. Some theorems related to the optimum filtering of non-stationary signals are also examined.

A general formulation of the multidimensional linear filtering problem is presented next and is used in finding the minimum mean-squared error, linear, time varying filters for multidimensional inputs. Both polynomial signals and signals which are sample functions of random time series are considered. The solutions to certain types of matrix integral equations which occur in this work are discussed.

The subject of random systems is examined from two different viewpoints. In the first case, a study is made of the filtering of signals which have been transmitted through a linear filter with certain random transmission characteristics. Both time varying linear filters with random parameters and linear filters with impulsive responses that are sample functions of random processes are discussed. In the second case, the design of optimum systems is studied when the components used to construct these systems have values which vary from their nominal values in some random fashion. It is shown that the optimum nominal values of such non-ideal components will differ from the values of perfect components except under certain special conditions.

Next, the problem of detecting signals in noise is considered for the multiple input model, where each of the inputs can contain one out of many possible signals. The detection procedure for this model becomes, in general, the testing of multiple hypotheses. Two detection criteria are examined for choosing between multiple hypotheses and it is found that for both criteria, the decision is based upon the calculation of the likelihood functions for the various signals. Systems for calculating these likelihood ratios are then examined for deterministic signals, with and without random parameters, and for signals which are sample functions of random processes. A multidimensional matched filter is introduced and its relationship to the detection problem is examined. The choice of signals which minimizes the probability of a wrong decision is found for the case when there can be only two possible signal combinations at the input.

Finally, a useful expansion is presented for stochastic processes which are functions of two variables. The utility of this expansion in specifying optical filters for the detection of signals in noise is examined. The defining relationship for an optical matched filter is derived and related to this optical detection problem.

Microfilm \$2.85; Xerox \$9.90. 219 pages.

ENGINEERING, MECHANICAL

SURFACE RECOMBINATION AND  
HEAT TRANSFER IN  
A DISSOCIATED DIATOMIC GAS

(L. C. Card No. Mic 60-6099)

William Brooks Cottingham, Ph.D.  
Purdue University, 1960

Major Professor: Richard J. Grosh

Recent interests in high temperatures, as found in rocket engines, controlled fusion reactions, and vehicle reentry into a planetary atmosphere have created new heat transfer problems. Particularly important among these is the problem of heat transfer in a dissociated diatomic gas.

Diatomic gases, at elevated temperatures, break up into atoms and ions with an attendant absorption of energy. If these particles are then allowed to migrate to surfaces

or to regions of lower temperature, there is a strong tendency towards recombination and the release of this absorbed energy. Heat transfer in these situations is then complicated by the need to account for this chemically stored energy of the stream.

This paper describes an apparatus that has been constructed and used to investigate the heat transfer from a dissociated diatomic gas. The test apparatus consisted of a glow discharge tube operable in the pressure range of 0.1 mm to 1 mm of Hg., through which pure hydrogen flowed and was dissociated. The temperature of the gas does not rise above approximately 120° F while the stream concentration can be varied from 0 to 75 per cent. Thus, high stream enthalpies were obtainable at a reasonably low temperature with a dissociated gas which would simulate the usual convection, momentum, and diffusion effects found with high temperature. The dissociated gas passed from the discharge tube into a test section in which it flowed normal to a stainless steel capillary tube used as a heat transfer surface. Three capillaries were used in the course of the investigation: 0.008" O.D., 0.031" O.D., and 0.125" O.D., giving Knudsen numbers varying from 4 to .08.

Concentrations of the dissociated gas were determined by means of a molecular flow gage employing a 0.003 inch I.D. capillary attached to a Pirani gage of 0.0003 cubic inch internal volume. Theory indicates that when one end of the capillary is exposed to a mixture of atoms and molecules while the other end is exposed only to molecules, a pressure difference is established across the capillary which is a direct function of the atom concentration. Experimental analysis of the gage showed an accuracy of  $\pm 1\%$  concentration and a time response of approximately 1 second.

Measurements were made and results are reported on the heat transfer to the surfaces for various degrees of dissociation. In addition, results are presented for the recombination coefficient on these surfaces as a function of pressure, temperature and concentration.

The recombination coefficients measured in this work show excellent agreement with those predicted by theory. However, some variability is noticed in these values and is thought to be an effect of the adsorption of a foreign substance on the surface. Heat transfer measurements show good agreement with theory in the free-molecule flow region. A decrease in value as compared to theory is noted in the slip flow region and is thought to be the effect of atoms and molecules shielding the surface as they leave. This shielding appears dependent on the concentration of the free stream.

Microfilm \$2.50; Xerox \$7.20. 155 pages.

# THERMOCHEMICAL EQUILIBRIUM IN HYDROCARBON-OXYGEN REACTIONS INVOLVING POLYATOMIC FORMS OF CARBON

(L. C. Card No. Mic 60-6109)

Norman Russell Gay, Ph.D.  
Purdue University, 1960

Major Professor: George A. Hawkins

Equilibrium composition and flame temperatures have been calculated for the reaction of acetylene and ethylene with oxygen over a range of mixture ratios.

Emphasis has been placed on the determination of conditions necessary for the formation of solid carbon in the products. The influence of the presence of long-chain carbon molecules on the mixture ratio and temperature required for carbon deposition has been investigated. Premixed flames of acetylene and ethylene have been studied experimentally to determine the correlation between theoretical calculations and actual combustion reactions.

Calculations indicate that, for acetylene, carbon begins to appear in the condensed form at an equivalence ratio of approximately 2.7 when the only forms of carbon considered are monatomic and diatomic. The equilibrium flame temperature is 3275° K. If longer chain forms of carbon are considered (consistent with a triple point pressure of about 100 atm. at 4000° K) then carbon formation begins at an equivalence ratio of 3.37 and the flame temperature would be 3095° K. This difference is not so pronounced in the other hydrocarbons considered.

Experimentally, conclusive evidence of carbon formation was apparent at an equivalence ratio of 2.9. Based upon the property data used, the experimental evidence would indicate the presence of carbon molecules containing up to five atoms of carbon. Of these forms the odd number species predominate.

Microfilm \$2.50; Xerox \$7.60. 162 pages.

# THE EFFECT OF RAIN INTENSITY ON THE PREVENTION OF ICING ON TRANSMISSION CABLES

(L. C. Card No. Mic 60-6116)

Chaim Zelman Kamien, Ph.D.  
Purdue University, 1960

Major Professor: O. W. Witzell

A uniform drop size shower apparatus was designed to investigate the effect of rain intensity on the power requirements for prevention of icing on transmission cables. The experimental results were compared with results calculated by means of an energy balance on the cable and were found to be in excellent agreement. The major contribution to the heat dissipated from the cable was found to be due to heat transfer by conduction which is primarily a function of the rain intensity.

This work was undertaken to show that the theoretical considerations are valid in computing the minimum power requirement to prevent icing on transmission cables.



It was found that the theoretical equation can be used for this purpose and minimum power requirement can be predicted. A set of curves is presented from which the power requirement for the prevention of icing on a 300 MCM transmission cable can be predicted from typical weather bureau information.

Microfilm \$2.50; Xerox \$4.20. 77 pages.

#### NON-LINEAR HEAT CONDUCTION

(L. C. Card No. Mic 60-6519)

George Chang-Ming Sih, Ph.D.  
Lehigh University, 1960

The classical theory of heat conduction is extended by assuming non-linearity in the relation between the heat flux vector and the temperature gradient vector. By an invariant-theoretic approach, the thermal conductivity tensor is found to be symmetric. The non-linear theory also shows that the form of the heat flux law is different for an isotropic body and body with cubic symmetry.

The dependence of heat flux on both the temperature and deformation gradients is investigated. The effect of deformation on the steady-state temperature distribution and heat transfer is obtained by solving the differential equation for particular deformations of the body which is initially isotropic. It is found that a particular deformation may change the steady-state temperature field and heat transfer depending on the physical properties of the material. The results, obtained in this paper, may be used to determine how the interaction between deformation and temperature gradients will affect the stress distribution in a body. Throughout this paper, the material is assumed to be homogeneous and perfectly elastic.

Microfilm \$2.50; Xerox \$7.00. 149 pages.

#### HEAT TRANSFER IN THERMAL RADIATION ABSORBING AND SCATTERING MEDIA

(L. C. Card No. Mic 60-6137)

Raymond Viskanta, Ph.D.  
Purdue University, 1960

Major Professor: Richard J. Grosh

The problem of heat transfer from media that absorb and scatter thermal radiation has been studied analytically. The fundamental quantities and definitions of the theory of thermal radiation are presented in a form useful for application to the radiant heat transfer problems. The aim was to formulate the various concepts with maximum generality. The basic equation of radiant heat transfer, which governs the radiation field in a media that absorbs, emits and scatters thermal radiation, has been derived. The mathematical analogy between thermal radiation and neutron transport is pointed out, and a few illustrations of the applicability of the solutions obtained for neutron transport problems to the radiative transfer problems are given.

The derivation of the integral equations for radiant heat exchange in a general enclosure composed of a system of surfaces separated by an absorbing and scattering media is presented. The enclosure walls under consideration can reflect specularly and the scattering from the medium is not considered to be isotropic. The equation for the conservation of energy, including contributions due to thermal radiation, was derived by evaluating the energy transported into an imaginary closed surface fixed in space and then by applying Gauss's divergence theorem. The formulations developed are then used to gain insight into the problem by considering a few simple physical situations and obtaining numerical results for the grey case only.

The Rosseland approximation for the radiant flux vector is employed in the study of Couette flow. It is found that for large optical thicknesses the temperature distributions calculated agree well with those predicted by the exact formulation.

Numerical solutions of the boundary layer equations for the flow of a radiating media along a wedge were obtained. The effect of radiation is to decrease the temperature gradient for both the hot and the cool walls; however, the heat transfer is affected only little. The validity of the diffusion approximation for radiation in boundary layer problems is limited, and should be used with caution only in situations where the mean free path of radiation is much smaller than the thermal boundary layer thickness.

The transport of radiant energy between two parallel plates separated by an absorbing and scattering media is studied. The temperature distributions were obtained by solving the nonhomogeneous Milne integral equation of the first kind. It was found that the polynomial approximation for the black body emissive power is satisfactory for all values of the optical thickness.

The transport of energy by simultaneous conduction and radiation in a one-dimensional system has been considered. A nonlinear integral equation governing the temperature distribution in an absorbing media was solved. The results showed that the temperature distribution was strongly dependent on the optical thickness of the slab and on the dimensionless parameter,  $N$ , which determines the relative role of energy transfer by conduction to that by radiation. The presence of radiation generally increases the heat transfer by conduction.

Microfilm \$2.65; Xerox \$9.25. 202 pages.

#### AN INVESTIGATION OF STRAIN-ENERGY ABSORPTION POTENTIAL AS THE CRITERION FOR DETERMINING OPTIMUM REACTOR-VESSEL CONTAINMENT DESIGN

(L. C. Card No. Mic 60-4933)

Walter Robertson Wise, Jr., Ph.D.  
University of Maryland, 1959

Supervisor: Dr. John E. Younger

The reactor-vessel containment work being currently conducted at the Naval Ordnance Laboratory is predicated upon the thesis that for every excursion-energy release and rate of release there exist particular values of

reactor-vessel design parameters which constitute optimum containment design. These parameters are taken to be material, configuration, constraint, and size. The purpose of the NOL Reactor-Vessel Containment Program is to determine, through an investigation of these basic parameters, the optimum containment design of nuclear-reactor vessels for a large range of excursion-energy releases, fluxes, and flux geometries. The purpose is being achieved through a fundamental investigation of the structural response of model reactor vessels to simulated excursion-type loading produced upon the internal walls of the simulants.

In a large measure, the effort reported herein is directed at assessing the effectiveness of strain energy absorption as a means for improving the containment potential of nuclear reactors. Consistent with the investigation of strain-energy absorption potential, the general strain-energy equation of dynamic equilibrium for a vessel subjected to internal dynamic loading has been derived in closed form. This general equation and its simplified working forms require knowledge only of the transient-pressure and strain-vector phenomena accompanying hydrostatic and dynamic dilatation.

Scaled reactor-vessel simulants have been dilated in the laboratory using a hydraulic pump and solid propellant, respectively, as the hydrostatic and dynamic loading mechanisms. The internal pressures and external strain vectors corresponding to the dilatations were monitored, and comprehensive analyses of structural response data are presented in tabular and graphical form.

The results obtained indicate that the mechanism of strain-energy absorption, alone, is not significantly effective in improving the containment design of nuclear reactor vessels. It is concluded instead that gross plastic deformation does have some potential for increasing the containment potential of ductile vessels and should be investigated further.

Microfilm \$2.50; Xerox \$8.20. 178 pages.

## ENGINEERING MECHANICS

### DAMPING PROPERTIES OF MATERIALS SUBJECTED TO VARIOUS RATIOS OF BIAXIAL STRESS

(L. C. Card No. Mic 60-5155)

Vincent Wester Anderson, Ph.D.  
University of Minnesota, 1960

The damping properties of materials has been the subject of considerable interest and research in recent years. The damping or internal friction inherent within a material itself is instrumental in controlling resonant vibration stress conditions in machine and structural members. The importance of material damping as an engineering property has been of increasing interest recently in view of reoccurring acoustic fatigue failures in aircraft structures.

Most of the work done by previous investigators in the field of damping of materials has been done under uniaxial

stress conditions. A state of biaxial stress exists in many members of machines and structures in which damping is a very important design consideration for safe and successful operation. Data on damping under biaxial stress is practically non-existent.

The purpose of this investigation was to study experimentally the damping properties of two metallic materials subjected to a state of biaxial cyclic stress as a function of the ratio of principal stresses and stress magnitudes. Various combinations of principal stress ratio  $\alpha$  from  $\alpha = 0$  (pure tension-compression) to  $\alpha = -1.00$  (pure torsion) were studied. It was also the purpose of this investigation to determine which criteria of combined stress are most applicable for defining damping properties.

A review of the literature showed that for ductile materials such as mild steel and copper the maximum distortion energy theory of combined stress checks test results most favorably for various strength properties, such as yield strength and fatigue strength. For brittle materials, such as cast iron, the maximum stress theory seems most applicable for defining strength properties under biaxial stress.

To produce various principal stresses  $\sigma_1$  and  $\sigma_2$ , various combinations of axial and torsional stresses were applied to the test specimen by the biaxial stress damping machine which was developed especially for this investigation.

The test program was conducted at room temperature using hollow specimens of SAE 1020 steel and pure copper. Damping tests were conducted using various principal stress ratios for three stress combinations: reversed stress, uni-directional tension-torsion and uni-directional compression-torsion.

The axial and torsional loads on the specimen were applied simultaneously at a constant ratio so that the ratio of principal stresses remained essentially constant during a damping test. The loads were slowly cycled, during which time the maximum axial and torsional stress amplitudes were applied in phase. The axial and torsional stresses and strains were measured using SR-4 strain gage techniques. Damping values are expressed in in-lb of energy absorbed per cu-in of material per cycle of stress and were obtained by a direct determination from the stress-strain hysteresis loops recorded by an autograph X-Y recorder.

Data are presented as hysteresis loops and  $D_0^C - \sigma_1 - \alpha$  and  $D_0^C - \sigma_2 - \alpha'$  plots. Based on the data and analysis presented in this work, the following empirical observations may be made: (1) The damping energy absorbed by a material subjected to combined reversed axial and torsional stress is greater than that due to either the axial or torsional stress acting alone. (2) The damping energy absorbed by a material subjected to cyclic uni-directional stress is significantly less than that under cyclic reversed combined stress of the same stress amplitude.

Based on the data analysis the following conclusions may be made: (1) The maximum distortion energy theory of combined stress is the most appropriate for defining damping properties of mild steel under reversed stress. (2) For copper under reversed stress the maximum strain energy theory agrees best with test results. (3) The maximum strain and maximum strain energy theories are the most appropriate for defining damping properties of both steel and copper subjected to uni-directional tension-torsion or compression-torsion.

Microfilm \$2.50; Xerox \$7.40. 156 pages.



# STRESSES IN ROTATING TAPERED DISKS WITH NONCENTRAL HOLES

(L. C. Card No. Mic 60-5872)

James Hal Armstrong, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: Glenn Murphy

This thesis presents an original method by which the critical stresses in a rotating tapered disk having symmetrically spaced noncentral holes can be reliably calculated. The method can be applied to any disk for which the solution without noncentral holes is known. The results of a photoelastic analysis are presented to confirm the theory.

The new approach, used, it is believed, for the first time in connection with rotating disks, introduces a phenomenon called the "spoke effect." This effect allows the outer annulus of the disk to expand somewhat more than would the corresponding portion of a disk having no noncentral holes. This may be thought of as a "relaxing" which is permitted by the removal of hole material.

The solution may be considered as consisting of these three parts.

1. Calculation of the radial and tangential stresses throughout for a disk similar to the given disk but having no noncentral holes. Such a disk is called a "filled disk."
2. Application of the spoke effect. This is accomplished by considering the material between the holes as removed and replaced by a set of uniform spokes, each one having a cross-sectional area equal to the original minimum spoke area and a length equal to the diameter of a noncentral hole. As the stress in such a spoke is higher than that in the corresponding material in the filled disk, the spokes will deform more than the solid material of the filled disk. This additional extension is based on the radial stress in the filled disk existing at the center-line of the noncentral holes, which stress is, in turn, adjusted in inverse proportion to the areas involved. The resulting additional extension is applied to the outer annulus according to thin ring theory but based on the average radius of the outer annulus. The additional stress is treated as constant and added to the tangential stresses obtained in part 1.
3. Employment of appropriate stress concentration factors for the type of hole involved. These factors are based on holes in an infinite uniform plate, since the taper has already been accounted for in the early calculations.

The resulting stresses check photoelastic results within five per cent at the free boundaries of the holes along a radial line through the center of a noncentral hole which are the points of critical stress. In general, the calculated stresses at other points along the radius mentioned are higher than the actual stresses. This apparent discrepancy is explained and discussed.

Microfilm \$2.50; Xerox \$3.80. 68 pages.

# AXISYMMETRIC FINITE DEFLECTIONS OF THIN ELASTIC SHELLS OF REVOLUTION

(L. C. Card No. Mic 60-3854)

Albert D. Graefe, Ph.D.

Polytechnic Institute of Brooklyn, 1960

Adviser: Joseph Kempner

It was desired to develop a means of computing the stresses and deflection of a metallic bellows used in control devices and other technological applications. At present there is not available in the literature any reasonably accurate method of computing the stresses and deflections of a thin elastic shell of revolution containing some fairly sharp curvatures and subject to loads that produce large deflections. The latter condition suggested the use of a method which uses the local strains as dependent variables instead of the displacements of a shell.

Solution of the above problem required the development of a general method for computing the axisymmetric finite deflections of thin shells of revolution subject to both internal and external pressures. To provide general application outside of the bellows problem under consideration, the equations developed allow for variation along the shell of both the applied pressures and the thickness of the shell.

The analysis is based on six differential equations for a general shell expressed in tensor form. Imposing the requirements that shell geometry, applied pressures, and shell displacements are axisymmetric reduces the number of equations to four. They are used to derive four nonlinear differential equations in terms of the four dependent variables radial membrane strain, circumferential membrane strain, radial bending curvature, and circumferential bending curvature of the middle surface of the shell. Two equations are first order and the other two equations are second order differential equations. Together with a fifth equation obtained by differentiating one of the above first order equations and suitable boundary conditions, a numerical method of integrating all five equations was developed and applied to a specific metallic bellows. Since the equations are not simultaneous in their highest derivatives, the numerical computation is greatly facilitated. Integrating a suitable function of the strains computed above gives the axial deflection of any point on the shell. The radial deflection has already been provided by the circumferential membrane strain. However, the above differential equations cease to exist at any radial location along the shell where there is a finite jump in either shell curvature, the first derivative of applied pressure, or the second derivative of shell thickness. Therefore it was necessary to derive a set of six "jump" equations to carry the integration process across what is for practical purposes an internal boundary.

Complete sets of equations and techniques have been developed to compute the strains, stresses, and deflections of a thin shell of revolution subjected to axisymmetric applied pressures and restricted to resulting axisymmetric shell deflections. The equations are quite suitable for computation with a digital computer. The shell can have a relatively small local radius of curvature, the shell

thickness can be variable, the local radius of curvature can change abruptly, deflections can be large, and it makes no difference whether membrane forces dominate bending forces or vice versa. Linearization and simplification of these equations produces results which check a variety of other theories currently in the literature of this field.

The computed results of internal pressure applied to a metallic bellows shows the location of maximum shear stress to be the inside surface of the inner radius of the bellows. This is a combined stress produced primarily by a strong compressive circumferential membrane strain and, perpendicular to it, a tensile stress produced primarily by a radial bending curvature.

Microfilm \$3.15; Xerox \$11.05. 243 pages.

# THE NON-EQUILIBRIUM DEBYE POTENTIAL IN A PLASMA AND ITS EFFECT ON THE KINETIC EQUATION

(L. C. Card No. Mic 60-5163)

Thomas Soneral Lundgren, Ph.D.  
University of Minnesota, 1960

This thesis is concerned with the rational derivation of the kinetic equations for a two component completely ionized gas.

The author uses the multiple kinetic equations of Born and Green,<sup>1</sup> Kirkwood,<sup>2</sup> and Bogolubov,<sup>3</sup> with an appropriate closure, to derive an approximate integral equation for the binary distribution function. This integral equation is then reformulated as an integral equation for the non-equilibrium Debye potential, which is reduced to a system of algebraic equations by taking its Fourier integral. These algebraic equations are then solved when the state of the gas is near equilibrium. With the results of this calculation the binary distribution function can be found by integration.

The author uses the resulting binary distribution function to calculate the collision term for the kinetic equation. This term is separated into two parts corresponding to the equilibrium and non-equilibrium parts of the Debye potential respectively. The first part gives a collision term which is the same as that derived by Landau<sup>4</sup> and is also the same as the Fokker-Planck type collision term derived by Rosenbluth.<sup>5</sup> This part of the collision term is then compared with Boltzmann's collision term in the thirteen moment approximation. They are found to be identical in this approximation.

The second part of the collision term is compared with the first part in the thirteen moment approximation where it is found that although this makes an appreciable correction to certain terms in the moment equations, these corrections affect the transport coefficients only negligibly.

1. Born, M., and Green, H. S., A General Kinetic Theory of Liquids, I. The Molecular Distribution Functions. Proc. Roy. Soc. A. 188, 10 (1946).

2. Kirkwood, J. G., The Statistical Mechanical Theory of Transport Processes, I. General Theory. J. Chem. Phys. 14, 180, (1946).

3. Bogolubov, N., Kinetic Equations, J. Phys. USSR, 10, 265 (1946).

4. Landau, L., Die Kinetische Gleichung für den Fall Coulombscher Wechselwirkung. Phys. Z. Sowjetunion, 10, 154 (1936).

5. Rosenbluth, M. N., MacDonald, W. M., Judd, D. L., Fokker-Planck Equation for an Inverse-Square Force. Phys. Rev. 107, 1 (1957).

Microfilm \$2.50; Xerox \$4.20. 76 pages.

# A CONTRIBUTION TO THERMAL STRESS ANALYSIS BY PHOTOELASTICITY

(L. C. Card No. Mic 60-5463)

Osvaldo Villafane-Marin, Ph.D.  
The Pennsylvania State University, 1960

In this thesis a new method for three dimensional thermal stress analysis by photothermoelasticity in solids of revolution is developed. This new method will be termed the embedded polariscope method. First the adequacy of the embedded polariscope method for representing both mechanical and thermal stress states is established by checking it against known stress distributions. These are the pure bending stress state for mechanical loading and the stress distributions in cylinders of square and round sections under thermal loading. A new equation of the Laplace type, involving the principal stresses in the plane of the polariscope is developed. It becomes possible thereby to separate the three principal stresses in the plane of the polariscope. Because of symmetry, this yields a complete solution for the magnitudes of the principal stresses in such solids of revolution. Methods for finding the isoclinics to complete the solution are suggested. The feasibility of an adequate experimental technique for the method is examined and developed. The method makes possible the determination of both transient as well as steady stress states.

In addition several new methods for determining the principal stress and temperature distributions in disks and the mid transverse section of cylinders directly from the photoelastic pattern are developed theoretically. The methods for stress determination make it unnecessary to know the temperature distribution in the section of the disk or cylinder. The methods for stress determination are furthermore valid without restriction for both the steady and unsteady states of temperature distribution. The methods for temperature distribution are valid for both the static stress state corresponding to steady temperature distributions and to the quasistatic stress states involved in the unsteady states of temperature distributions.

Microfilm \$2.50; Xerox \$6.60. 139 pages.



## ENGINEERING, METALLURGY

SULFUR SEGREGATION AT  
ALPHA-IRON GRAIN BOUNDARIES

(L. C. Card No. Mic 60-4520)

Norman G. Ainslie, Ph.D.  
Rensselaer Polytechnic Institute, 1960

Supervisor: David Turnbull

Radioactive sulfur has been introduced simultaneously into single crystal and polycrystal specimens of high-purity alpha-iron by reaction with  $H_2S$ . After lengthy annealing and rapid quenching, the polycrystals are found to contain 50 to 100 per cent more sulfur than the single crystals, and the excess sulfur in the polycrystals is found to be concentrated at the grain boundaries. All available evidence indicates that the sulfur was in solid solution at the equilibration temperature, although the amount of sulfur segregated at the boundaries is much greater than can be accounted for on the basis of equilibrium adsorption.

Further study using the technique of transmission electron microscopy revealed that the grain boundaries of the sulfurized iron were commonly associated with very high density dislocation networks that could extend several microns into the bulk of the grains. The dense networks were not observed in pure, sulfur-free iron. The networks are thought to form when the sulfur, having first entered the specimens by preferential diffusion along grain boundaries, diffuses from the grain boundaries laterally into the grains. The sulfur, which diffuses in iron as a substitutional element about 30 times faster than iron self-diffuses, establishes a diverging vacancy flux toward the boundaries. The result is a vacancy undersaturation in the neighborhood of the boundaries that accounts, it is believed, for the high dislocation density; the vacancy undersaturation causes dislocation multiplication by "down-climb."

The abnormal segregation of sulfur in the vicinity of alpha-iron grain boundaries is explained if it is assumed that sulfur is adsorbed by dislocations in the boundary networks. The possible effects of these grain boundary networks upon certain other metallurgical phenomena are considered. Microfilm \$2.50; Xerox \$3.80. 69 pages.

X-RAY DETERMINATION OF RESIDUAL  
STRESSES IN ELECTRODEPOSITED  
NICKEL COATINGS

(L. C. Card No. Mic 60-5419)

Glenn Wilson Bush, Ph.D.  
The Pennsylvania State University, 1960

Because the methods currently being used to evaluate stresses in electrodeposited metals are not applicable to specimens other than those prepared for stress deter-

minations, the present investigation was undertaken to adapt the x-ray diffractometer method of measuring lattice strains for use in determining the stresses in electrodeposited nickel.

The algebraic difference between the angular positions of the diffraction peaks for a given set of lattice planes for the normal and inclined measurements on various specimens was determined and converted to stress by use of an experimentally determined calibration curve. In developing a procedure for such use of x-ray diffractometer measurements, attention was first directed to the evaluation of factors which would affect the precision and accuracy of the results. With the proper choice of radiation, diffraction peaks from very thin layers (less than 0.5 to 1.0 mil) of the deposited metal can be obtained without interference from the basis metal. By use of a  $3^\circ$  collimating slit, and by removal of the receiving slit and Soller baffle to eliminate all traces of resolution of the  $\alpha_1$  and  $\alpha_2$  peaks, a least squares method of fitting a parabola to intensity data could be used to locate precisely the diffraction peaks. The experimental data were corrected for the Lorentz-polarization and the absorption effects. A basis was given for the correction factors to be applied to experimental data to compensate for the change in diffracted intensity with diffraction angle which occurs for extremely thin deposits ( $< 0.25$  mil). Experimental determinations of the elastic modulus of nickel electrodeposits revealed that this property is dependent upon the plating conditions of the deposit. Thus, it is necessary to determine experimentally a calibration curve for every set of specimens prepared under different plating conditions.

With the procedures outlined in this investigation, a precision of  $\pm 4000$ -6000 psi was attained in determining the stresses in electrodeposited nickel specimens. Within these limits of error, it was found that the stress in several electrodeposited specimens was uniformly distributed over the irradiated area of the specimen. With the plating process used in this investigation, it was not possible to reproduce the same level of residual stress in two groups of electrodeposited specimens by controlling the temperature, pH, surface tension and the current density of a given plating bath. After suitable stress relief of the specimens, each of which consists of a layer of nickel deposited upon a steel sheet, it was found that the experimentally determined residual stress agreed with the stress theoretically calculated for the specimens from consideration of the elastic moduli and coefficients of expansion of the metals which comprise the specimens.

Microfilm \$2.50; Xerox \$5.80. 116 pages.

A LOOP FOR CIRCULATING LIQUID  
LEAD-BISMUTH MIXTURES:  
CORROSION STUDIES AND OPERATION.

(L. C. Card No. Mic 60-4890)

John Charles Clifford, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: George Burnet

The comparative resistances of six ferrous alloys, containing from 0 to 26.5 per cent chromium, to attack by the eutectic melt of lead-bismuth have been investigated using an isothermal, dynamic testing technique. The 96-hour tests were conducted in the temperature range 600 to 900°C, and materials evaluations were made on the basis of the amounts of iron and chromium appearing in the melt during exposure, and on metallographic examinations of the test specimens after exposure.

It was found that chromium was selectively removed from the alloys by lead-bismuth and that the amount removed increased as the chromium content of the alloys increased. Removal of chromium was the principal reason for the deterioration of the alloys, particularly at the higher temperatures. Comparison of the corrosion resistances of the chromium-alloyed steels and a steel containing no chromium indicated that small amounts of chromium provided some corrosion resistance, but that larger amounts did not improve corrosion resistance.

On the basis of these tests two of the materials, a 2 $\frac{1}{4}$  chromium-1 molybdenum alloy steel and AISI type 430 stainless steel, appeared useable as container materials for experimental systems below 700°C. Above this temperature the deterioration of all the steels was too rapid to consider these alloys even for very short time use.

Some temporary reduction in the severity of attack of type 430 stainless steel was effected by exposing the steel surfaces to oxidizing conditions before testing. However, the protective film formed by such treatments was not continuous and did not appear to be self-healing in the presence of lead and bismuth oxides. Marked reductions in corrosion were produced by saturating the lead-bismuth with chromium before tests, but such a technique is practical with lead-bismuth only under isothermal conditions.

Several pieces of equipment, including two flanged connections, a cold trap, and a modified diaphragm pump, have been tested in circulation loops to determine their suitability in experimental lead-bismuth systems. The flanges proved satisfactory at temperatures as high as 650°C, and the cold trap effectively prevented precipitation of corrosion products in the piping of the circulation system. The 1 gpm pump performed satisfactorily in a system operating between 400 and 500°C, and it appears suitable for use with lead-bismuth where the required flow rates are low.

Microfilm \$2.50; Xerox \$6.00. 125 pages.



## FINE ARTS

### CULT STATUES OF THE MADONNA IN THE EARLY MIDDLE AGES

(L. C. Card No. Mic 60-5092)

Irene E. Haering, Ph.D.  
Columbia University, 1960

In the early Middle Ages iconic statues representing the Madonna and Child were made in western Europe of precious materials, primarily gold repousse adorned with rich gems, or of simple, polychromed wood. These figures, severe and hieratic in appearance, were free-standing images ordinarily placed on the altars of medieval churches or exhibited on pedestals behind the altar where they were the objects of fervent cult practices. The devotion of the faithful often caused them to be carried in procession or to be thought of as miraculous Virgins responsible for a large body of legend.

Although cult statues of this type were previously thought to have originated as the first sculpture in-the-round in the Christian West in the latter half of the tenth century, a number of factors now suggest that free-standing sculpture must be traced back to the Carolingian era. In addition to the implications of literary sources such as the *Libri Carolini* and the writings of Agobardus, specific religious and profane sculptures in-the-round are known to have existed in Carolingian times. In the last half of the ninth century these early statues were joined by a new type of sculpture, i.e., reliquary figures which were essentially cult statues. They were free-standing religious images representing saints or the Madonna and Child. Sacred relics were placed inside the statue in a reliquary compartment. The Ste. Foy in Conques from the late ninth century is the earliest extant object of this order. It must be stressed that the use of relics in this connection was instrumental not in reviving statuary in the West, but in accelerating its acceptance in areas of western Europe

still antagonistic to the idolatrous overtones previously associated with images in-the-round.

Antecedents to the cult statues representing the Madonna and Child may be seen in Gallo-Roman statues of pagan mother-goddesses often confused with Christian images of the Virgin and in folk idols of rude, sculptural form which persisted in western Europe during the early Middle Ages. Although Christian models of the Virgin and Child, well established in mosaic, painting and ivories, surely determined the iconographic type of the cult statue of the Madonna, pagan sources should also be considered. Purified by the addition of Christian relics, the pagan mother image became an acceptable contributor to Christian imagery.

When fully developed the complex iconography of the Romanesque Madonna and Child cult statue stresses the many-faceted character of Christ and his relation to the Virgin who is not only Mother of God but also Queen of Heaven, the Church and the Throne of Wisdom.

Literary sources indicate that cult statues of the Madonna were well known before 1100. The preserved Madonnas of the Ottonian period, from the Essen Virgin of c. 980 to simpler statues dating from about 1100, illustrate clearly the importance of the cult statue of the Madonna in the development of pre-Romanesque style in Germany. Related examples may be seen in Belgium from this early period.

In the twelfth century, as the statues became more numerous, they yielded their position as progressive carriers of style to monumental stone sculpture. No longer reliquaries, these figures absorbed the stylistic influence of northern France and blended it with the earlier hieratic manner. They were products of a late phase of Romanesque art.

A catalogue of extant sculptures supplemented by a map illustrates the dissemination of the cult statue of the Madonna throughout western Europe.

Microfilm \$5.00; Xerox \$17.80. 391 pages.

## FOLKLORE

### THE BACKGROUND AND SOURCES OF AN AMERICAN FOLKSONG TRADITION

(L. C. Card No. Mic 60-5156)

Eugene Bluestein, Ph.D.  
University of Minnesota, 1960

This thesis deals with the attempt to identify an American folksong tradition. The problem is discussed in terms of the deep-rooted notion that American culture is a derivative of a distinctly native folk tradition. In order to

understand the persistent denial of a folksong tradition in America, therefore, it is necessary to discover the roots of the conception that folksong is intimately connected with the development of national culture.

The locus classicus of this point of view is the work of the eighteenth century German scholar, J. G. Herder. Herder developed the notion that folksong is the source for the creation of national literary traditions and the means by which an international culture may be achieved. Despite the fact that Herder's views were adopted by nineteenth century folklorists to bolster their romantic predilections,

both Emerson and Whitman were aware of Herder's basic views. Whitman, especially, based his arguments for the existence of a native literary tradition on the Herderian principle that each nation draws its literature from the wells of its folk culture. Whitman developed fully the democratic implications of Herder's view that the highest literary values may be derived from the creations of the common people. Thus, according to Whitman, America presented the fullest opportunities for the application of Herder's conceptions.

In the twentieth century, most folklorists accepted the notion that American folksong was a derivation of British ballad traditions. John and Alan Lomax were the first to propose that America had created its own tradition of folksong. In their formulations it is possible to identify

leading ideas which are remarkably similar to Emerson and Whitman. For the Lomaxes, American folksong illustrated the democratic traditions historically associated with American development. For this reason, they identified Negro folksong as the fullest flowering of American folksong: spirituals, blues, and other characteristically Negro folksong traditions were uniquely American. The major motifs of American folksong emphasized egalitarianism and the desire for freedom. In fact, according to the Lomaxes, the distinctive aspect of American folksong was its affirmation of the worth of the "outcast" and the Negro. Finally, the Lomaxes asserted that to understand the American folksinger was the first step in understanding the oral traditions of all nations.

Microfilm \$2.75; Xerox \$9.45. 210 pages.

## FOOD TECHNOLOGY

## A STUDY OF SOME FACTORS INVOLVED IN MILK LIPASE ACTION

(L. C. Card No. Mic 60-5622)

Vernal Sidney Packard, Jr., Ph.D.  
University of Minnesota, 1960

The influence of several surface active agents on the activity of milk lipase was measured by fat acidity titration. The effects of these reagents on non-activated and induced lipolysis were observed in both "normal" and "spontaneous" milks. Also, an investigation was made of several cows having a previous history of "spontaneous" rancidity. The influence of University management practices was compared with their previous treatment with respect to both "spontaneous" and "pipeline" milking.

Addition of an anionic reagent, sodium heptadecyl sulfate, produced a slight stimulation of lipolysis in "normal" milk incubated at both 37°C and 5°C. Temperature (cooling-heating-cooling), agitation-foaming, homogenization and surface (increased air surface to volume ratio) induced lipolytic reactions were either unaffected or only slightly enhanced at low concentrations of anion and inhibited at higher concentrations.

A cationic reagent, alkyl ( $C_9 - C_{15}$ ), tolyl methyl trimethyl ammonium chloride, stimulated both non-activated and, to a greater extent, induced lipolysis. Mixtures of anionic and cationic reagents stimulated lipolytic activity substantially in uncooled "normal" milk, whereas lipolysis in activated milks was only slightly stimulated. Several surface active agents, both anionic and cationic were observed to markedly stimulate lipolysis in uncooled "spontaneous" milk.

In order to evaluate potential requisites of lipase activation, several experiments were designed to investigate the influence of surface active agents and induced activation treatments on certain characteristics of the milk system. Cream volume was found to be significantly increased only in the presence of mixtures of anionic and cationic reagents. At the concentrations of these reagents which were known to activate lipase, only the anion reduced the surface tension substantially and with mixtures of these reagents the surface tension appeared to reflect the effect of the anion alone.

Phospholipid and xanthine oxidase distribution were used as measures of fat globule "membrane" stability. The anion liberated a large amount and the cation smaller quantities of the phospholipid from the fat globule surface. Mixtures of these reagents appeared to free phospholipid in amounts that were approximately equal to the sum of quantities liberated in the presence of these reagents alone. Xanthine oxidase distribution between fat and skim milk was found to be influenced to some extent by mixtures of these reagents as well as by various lipase activation treatments.

The above findings appeared to point out the importance of interfacial tension and "membrane" characteristics in the lipolysis reaction.

Proper management practices have been found to alleviate the "spontaneous" lipolysis problem. Highest A.D.V. values were noted in the latter stages of lactation during those months when the cows should have been dried-off. Pipeline milk samples from these cows were generally higher than those observed in University-reared cows.

Microfilm \$2.50; Xerox \$8.20. 177 pages.



## GEOGRAPHY

### A GEOGRAPHIC STUDY OF URBAN SERVICE AREAS, WITH SPECIFIC REFERENCE TO LA CROSSE, WISCONSIN.

(L. C. Card No. Mic 60-4714)

Margaret Sarah Chew, Ph.D.  
Clark University, 1960

Supervisor: Raymond E. Murphy

The purpose of this study is threefold: to analyze and interpret the progress that has been made in the study of urban service areas, to make a geographic study of the service areas of one specific middle size city - La Crosse, Wisconsin - and to determine reliable methods of studying and mapping the influence of a city in the region. Because of the over-all influence of a large metropolitan center it seems feasible that a state or group of states can best be divided into regions based upon the service areas of middle size cities.

La Crosse, Wisconsin, is a middle size city situated on a terrace in the Mississippi River Valley in a tri-state area. There are eight competing middle size cities within a radius of one hundred and fifty miles. The hilly topography of southwestern Wisconsin and adjacent parts of Iowa and Minnesota channel the flow of traffic in and out of La Crosse through the major river valleys. The site and situation make La Crosse an interesting city for service area study.

Most maps that have been made on service areas have used lines around zones or are based on the county unit. This study uses minor civil divisions.

One phase of the research involved interviewing managers of service agencies and wholesalers within La Crosse and drawing their service areas on maps. A median line service area map based on fifteen combined types of services is presented as one good way to show the dominant influence of a city in the region. The zone serviced by at least seventy-five per cent of the fifteen combined services is called the "Focalsphere."

A second method of research involved interviewing store managers in four sectors radiating out from La Crosse. Managers of grocery, drug, and hardware stores were interviewed to find out what percentage of their merchandise was purchased from La Crosse and what cities were the leading suppliers of merchandise. A La Crosse whole-sale service area map was made from this study.

A third phase of research was made with the assistance of high schools and colleges. Questionnaires on shopping and service habits were filled out by families in the Tri-State Area. The Primary Service Area of La Crosse is mapped from these statistics compiled by townships on a combination of types of services. This map is presented as the best method found in this research for dividing a state or group of states into urban service areas.

"Breaking points" of trade between La Crosse and its eight competitors are mapped along township boundaries.

Maps showing individual and combined service areas of La Crosse, percentages of La Crosse services utilized in the surrounding region, and the relationship of intensity and distance of La Crosse service area are all based on minor civil division statistics from family questionnaires.

This study concludes that it is possible to divide a region into mutually exclusive dominant service areas of middle size cities if small units of area - minor civil divisions - are used for plotting the statistics, and if the degree of importance of the central city is obtained from families in the region. All townships where at least fifty per cent of the families select the same central city are put into that City's Primary Service Area.

Service areas are mobile and change with conditions. Therefore, in our dynamic world there is a need for delimiting trade and service areas at regular intervals to keep up with modern trends and changes.

Microfilm \$4.20; Xerox \$14.85. 326 pages.

### LAND USE CHARACTERISTICS IN AND AROUND THE CENTRAL BUSINESS DISTRICTS OF EIGHT CITIES

(L. C. Card No. Mic 60-4716)

John Tait Davis, Ph.D.  
Clark University, 1960

Supervisor: Raymond E. Murphy

A good deal of concerned attention has been paid of late to the downtown business areas of modern cities. This attention is directed into three principal paths: (1) the solutions to problems such as declining retail importance, and traffic congestion, (2) speculations as to the future nature of the downtown business area and (3) delimitation and analysis of the existing central business district. The present investigation falls into the third of these categories.

Such expressions as "Fringe Area" and "Hard Core" are widely used in reference to the downtown business area. However, their precise definition is not yet achieved; their precise characteristics remain undefined. Certainly, investigations of problems relative to the central business district would be much aided by some theoretical description of the downtown area.

Underlying the present analysis is a thesis, phrased here in terms of the "Hard Core" but implying a definition of other parts of the central business district in terms of the same criteria. The thesis is that the "Hard Core" within the central business district should demonstrate (1) highest intensities of central business uses and (2) a distinct land use association.

Specifically stated, the problem considered here is twofold: (1) the development of a method by which intensities of central business uses may be measured, and a method whereby land use associations may be described

in a manner permitting the comparison of these factors from city to city, and (2) the derivation of a theoretical description of the central business district on the basis of an analysis of variations in the intensity of central business uses and the land use associations.

Intensities of central business use are measured by means of participation ratios calculated for block units in eight cities. Such a measure is, in effect, a measure of relative intensity or concentration of central business use.

Most of the 463 blocks considered are occupied by several uses, some of greater relative importance than others. In an attempt to eliminate those uses of little significance, and adaptation of Weaver's technique for deriving crop combinations is used.

The distribution of participation ratios derived for each downtown area has two aspects warranting consideration: (1) the abstracted distribution and (2) the distribution of these ratios on the ground. These aspects, tested statistically and cartographically, compare very well from city to city. When these intensities are related to the land use associations, again, a consistent relationship may be observed between the intensity of central business use and specific land use associations.

On the basis of the present investigation it is possible to differentiate three sub-areas within the central business district. Unique land use associations and unique intensities of central business uses are characteristic of each sub-area. The three sub-areas may be named as follows: (1) the Peak Land Value Blocks, (2) The Hard Core and (3) The Fringe Area. It is interesting to note that in none of the cities considered is the Hard Core at the peak land value intersection. Rather, it tends to be oriented about the geographic centre of the CBD, as delimited by Murphy and Vance. It would appear that attempts to identify the Hard Core with the peak land value intersection are misguided, if the Hard Core is to be associated with maximum intensities of use.

Microfilm \$2.50; Xerox \$8.60. 188 pages.

#### RECIPROCAL GEOGRAPHIC INFLUENCES OF THE TRANS-PACIFIC GALLEON TRADE

(L. C. Card No. Mic 60-4543)

Pablo Guzmán-Rivas, Ph.D.  
The University of Texas, 1960

Supervisor: Donald D. Brand

This study is a geographer's interpretation of the significance of the trans-Pacific galleon trade (1565-1815) in terms of the reciprocal geographic influences that were exchanged between the Philippines and New Spain during that period. The trade involved much more than merchandise and silver. It became a means for cultural interchange across a formidable oceanic barrier. It created and stimulated socio-economic forces which caused geographic changes and modifications. The trade involved immigration and merchandise in disproportionate ratios: a considerable volume of merchandise with a few migrants moved eastward to Mexico, while colonists, soldiers, friars, and government officials in effective numbers, together with some supplies and provisions, moved westward

to the Philippines. Therein lies the explanation for the lack of balance, as it were, between the effect of Malayo-Asiatic influences on New Spain, which appears to have been a transitory effect, limited, with no residuals of much consequence discernible now, and the effect of Spain and Hispanic America on the Philippines, which was pervasive, effective, and persistent even today as a result of a policy of outright cultural implantation.

The immigration of Malaysians and Asiatics into the Pacific coastlands of southwest Mexico was fortuitous, and involved very small numbers of mostly ineffectual individuals who were apparently rapidly assimilated into the mass of *Indios* and *castas* of New Spain. From an examination of food patterns in southwest Mexico, utilization of woodland and farm resources, household crafts, house types, and the practical arts, it does not appear that the coexistence of the native Mexican and the migrants from the Far East in the seventeenth and the eighteenth centuries resulted in any permanent or discernible modification of any aspect of the native culture in southwest Mexico. On the other hand, since the galleon trade depended solely on the Sino-Philippine trade, the fairs of New Spain were glutted with Oriental merchandise which created certain Asiatic orientations in commercial art forms and crafts.

For the colonization of the Philippines, the galleon trade became, in some ways, an effective instrument which played a part in changing and modifying certain phases of the economic geography of the Islands. Government policy was not by intent designed to dislocate the existing native social and economic organization. But the requirements of the trans-Pacific trade, upon which the life of the Spanish colony depended, fostered the need of mobilizing the country's resources by increased farm output, by introducing economic plants of the New World, cattle raising, shipbuilding, and by the production of farm surpluses, all of which induced changes and re-orientations in the physical and cultural landscape of the archipelago, and departures from the pre-Spanish economic patterns.

If the trans-Pacific trade was an instrument of colonization, it may also be considered, up to a point, as an instrument which brought about certain aspects of literary and linguistic hispanization of the Philippines. The colonial book trade featured "paperbacks" of pseudo-historical narrations, romantic novels, and pious literature which created a strong impression on the natives, and stimulated the production of metrical romances as well as sorrowful compositions dealing with the mysteries of the Christian religion. At the same time, coexistence with the Spaniards fostered the creation of *filipinismos* and contact vernaculars, and the assimilation of a considerable vocabulary into the native languages.

Microfilm \$4.65; Xerox \$16.45. 363 pages.



**METROPOLITAN STRUCTURE:  
PATTERNS OF CONCENTRATION  
FOR SELECTED ECONOMIC FUNCTIONS  
IN THE BOSTON AREA.**

(L. C. Card No. Mic 60-4719)

Lane Joseph Johnson, Ph.D.  
Clark University, 1960

Supervisor: Raymond E. Murphy

A metropolis, core of a metropolitan region and center for highly specialized functions, may be thought of as a self-contained unit for many, more common, "low level" functions. Parts of the whole, being bound together by patterns of movement, are not self-contained for these "low level" functions. However, they approach the capacity for independence to one degree or another. The problem of this dissertation was to differentiate among parts of the metropolis according to their capacities to provide their residents with "low level" facilities and to investigate patterns formed by communities so differentiated.

Investigation was restricted to employment and retail trade. Total employment figures were used. Retail trade, however, was sampled by eight types of goods and service establishments.

Locus of the study was the 1950 Boston Standard Metropolitan Area. This delimitation was considered a suitable approximation of the metropolis, largely because New England SMA's are relatively finely drawn, being built up of minor civil divisions. These divisions, towns and cities, were unit areas for capacity measurement.

Measurement assumed metropolitan unity for the selected "low level" functions. SMA totals for each facility and each group served by a facility were represented by one hundred percent, thus making measures for these unlike items directly comparable. Matching facility and served group percentages for a community resulted in a capacity index, 100 indicating perfect association. Indices above and below 100 indicate proportionate surplus or lack of the facility. Percentages measure gross centrality, or absolute concentration, and indices measure degree of surplus centrality, or concentration above local needs. Both measures have striking advantages of precision and objectivity, and their relationship to the concept of centrality gives the study much of its significance.

Wide variation among measures for different facilities in a community was the rule, indicating that such measures are reliable only for the function, or functions, upon which they are based.

The thirteen patterns of independence capacity, differentiating between communities capable and incapable of supporting their resident populations, have an underlying similarity and indicate the basic structure of the metropolis. Boston, always first in absolute amount, usually stands out as a center of surplus. Adjacent to Boston are other surplus communities, subcenters or satellites, which share its focal role. Some distance from this core lie a few scattered subcenters. And, around the core and outlying subcenters, are the tributary areas, or suburbs.

Utilizing the same data, five balance capacity patterns add detail to this basic structure; they point up communities of extreme excess or deficit and communities in which facilities and served groups are essentially in balance. The balance capacity pattern for employment differs sig-

nificantly from those for retail trade. The employment pattern is characterized by core excess and by widespread deficiency elsewhere. On the other hand, retail trade balance is widespread, existing even at the core. Communities of retail trade deficiency and excess are relatively few. On all balance capacity maps, underlying metropolitan structure is apparent in the quite regular location of relative concentrations, excess and balanced communities, among the deficit communities.

Capacity patterns are explained by the combined influence of many factors. Most important for concentration is good accessibility to a surrounding area, the metropolis for the primary center and subareas for other centers. Other factors, including location cost and accessibility to daily traffic, are also important.

Similar studies in other areas are desirable and feasible. However, they would face difficulties of data collection encountered in this study and probable additional difficulties in the delimitation of the metropolis and its parts. Further recommendations for research are contained in the final chapter.

Microfilm \$2.70; Xerox \$9.45. 208 pages.

**THE SPACING OF URBAN PLACES  
IN THE UNITED STATES**

(L. C. Card No. Mic 60-5671)

Leslie John King, Ph.D.  
State University of Iowa, 1960

Chairman: Dr. Edwin N. Thomas

The distribution of urban settlements over the surface of the earth is a phenomenon which has already attracted considerable attention from geographers and economists alike. However, to date these studies have relied upon the use of arbitrary and predetermined population-size classes as a means of classifying the towns and thereby facilitating the establishment of average distances separating towns in the same population-size group. In addition, few attempts have been made to consider the importance of any economic or physical variables upon the relative spacing of towns in an area.

In this study of the spacing of urban settlements within the United States, the emphasis is initially placed upon the establishment of a population-size interval for each sample town, within which it can be maintained with a certain level of probability, that towns differ in population-size from the sample town only by chance. The nearest neighbor of the same population-size is then identified for each sample town, and the distance separating the two settlements is measured. These distances serve as the dependent variable in the subsequent correlation and regression analysis. Certain economic and physical factors, more specifically, the population-size of the sample town, the scale of farming operations in the surrounding rural area, agglomerative forces in manufacturing, the density of rural farm and total population in the surrounding area, and the level of income and agricultural productivity in this same area, are hypothesized as being related in some direction to these variable distances. These hypotheses are tested by correlation and regression analysis within the framework of

modern probability theory. Throughout, considerable attention is given to the assumptions underlying the statistical models and every effort is made to ensure that these assumptions are fulfilled.

The level of explanation which is achieved in the regression analysis is not particularly high. This is true when each of the above factors is considered independently with distance, and also when all six independent variables are considered simultaneously. Mapping of the residuals from regression reveals only very broad areal patterns. The subsequent analysis is concerned with establishing the relevance to the problem of certain regionalizations and classificatory groupings. The models employed in this phase of the study are covariance analysis and tests of the significance of differences between correlation coefficients. The significance of a grouping based on the physical slope characteristics of the area in which a town is located, in helping to increase the level of explained variation, suggests that the physical factor may be worthy of more detailed consideration.

The limitations of the study in terms of the operational definitions which are employed, and the variables which have still to be considered, are continually stressed. Also, there is inadequate understanding of the importance of a stochastic element in the relative spacing of towns.

Microfilm \$2.50; Xerox \$6.40. 132 pages.

#### UPPER SILESIA: KEY TO POLAND.

(L. C. Card No. Mic 60-5102)

Wladyslaw M. Lotkowski, Ph.D.  
Columbia University, 1960

Upper Silesia, located at the eastern end of the industrial belt of Europe, constitutes a small portion of Poland's area. The importance of the region stems primarily from its large coal reserves and its iron and steel industry.

The thesis of this study is that the economic development of Poland depends crucially on the resource complex of Upper Silesia. Without these resources, it would be extremely difficult for Poland to escape a large measure of economic control by a foreign power, as well as to solve the problem of underdevelopment and underemployment. With Upper Silesia integrated into her economy, Poland has a good chance of achieving a balanced agricultural and industrial economy.

Artificially divided during the inter-war period, included within Poland since 1945, and still awaiting the final peace settlement with Germany, Upper Silesia presents international implications of the first magnitude. In the world of today the problem is not a local question between Germany and Poland, but an issue which vitally threatens the future economic well-being and progress of East Central Europe, and thus the tranquility of the Continent and of the world at large.

The international character of the problem has been recognized on different occasions, and the Second World War once more brought it before the political world. It is of the utmost importance that any decisions reached concerning Upper Silesia should come not as incidental results of diplomatic discussions, but as the outcome of a full knowledge of the case.

Throughout the period of some 200 years during which Upper Silesia remained within Prussia and the Reich, its geographic location was the greatest drawback to its industrial development. Because of its unfavorable competitive position in the German market, as well as in the restricted market in occupied Poland, Upper Silesia was unable to develop fully its productive potential, and its importance in the German economy was relatively small.

During the nineteenth century, when the economy of northwestern Europe was experiencing basic changes, Poland's backwardness continued, under the political and economic domination of foreign powers. Thus, after one thousand years of existence in the heart of the continent that initiated the Industrial Revolution, Poland in the first decades of the twentieth century remained an underdeveloped country.

With the outbreak of the Second World War, Poland's short-lived political existence was extinguished again. The main effects of this catastrophe were an unprecedented destruction of life and property, an imposed alien political and economic philosophy, a forced industrialization, and a westward shift of the country's geographic area. Poland's present territory, about twenty per cent smaller than its prewar size, includes the industrial region of Upper Silesia whose mineral resources and productive potential are vital to the economic development of the country.

Since the liberation of Poland and the incorporation of Upper Silesia, the economic situation of the region has been fundamentally changed. For with very meager resources and few industries outside Upper Silesia, the region became the mineral storehouse and the industrial core of Poland. Instead of the chronic problem of markets, Upper Silesia, as the only major source of coal in Poland, has no competition. Furthermore, because of the constant and increasing demand for its products, it has been able to expand its output of coal and steel to the highest level in its history. For the same reason, Upper Silesia became of key importance in Poland's economy, and a vital factor in the transformation of her economic structure. Now industry, rather than agriculture, holds the dominant position. Microfilm \$3.30; Xerox \$11.70. 256 pages.

#### AN INTRA-CITY COMPARISON OF SELECTED RETAIL BUSINESS LAND VALUES IN WORCESTER, MASSACHUSETTS.

(L. C. Card No. Mic 60-4723)

John Earl Rickert, Ph.D.  
Clark University, 1960

Supervisor: Raymond E. Murphy

This study compares business land values in three different urban situations in Worcester, Massachusetts: the Downtown and two principal outlying centers. One of these centers, Lincoln Plaza, is completely planned, while the other, Webster Square, is partially planned and partially unplanned.

Decentralization of business functions is, in a sense, a new phenomenon. Prior to the 1920's, land values in the Downtown areas increased geometrically as the population of the area increased arithmetically. Since this time, and



especially in the 1950's, land values in the Downtown have decreased. However, often there is a lag between the lowering of values in the Downtown and general recognition of this fact. The rise of values in outlying centers is difficult to assess due to the lack of a comparable situation.

Prior to decentralization, the Downtown offered a dynamic example of growing business concentration and valuation in the city, and frequent bidding for Downtown locational advantage kept appraisers well-informed as to the market value.

Urban land value theories appear to be a mixture of broad generalizations concerning future growth, applications of classical rent theory, and applications of classical supply and demand theory. These theories are useful for explanation but not particularly so for measurement on a comparative basis.

Efficiency in the utilization of business land is measured in terms of productivity. Therefore, the value of retail land, whether it is located in the city's central business district or in an outlying center, is created by the volume of business and earnings that may be developed by the tenantry.

The volume of business, then, depends on consumer population spending, their needs and desires for merchandise, and their convenience to this merchandise. Since the institution of standard brands, needs and desires for particular merchandise are considerably less important. Decentralization of resident population, however, has made business location more important.

Ultimate success in appraisal of business land necessitates close scrutiny of functions using the land. These functions are examined here with particular reference to store type. However, parking and various factors of business related to use and appraisal are also considered. The different functions have individual requirements determining their success or failure. Therefore, to better understand these individual needs, a series of tables and descriptions are presented to measure twelve business functions within the city. These twelve functions-- Restaurants, Supermarkets, Food Specialty stores, Package stores, Women's Apparel shops, Shoe stores, Furniture stores, Household Appliance stores, Drug stores, Variety stores, Department stores, and Jewelry stores--are compared in the three areas. The Census of Business is used to measure the Downtown while questionnaires are used to measure the specific functions in the outlying centers.

Business volumes are then compared to the population analysis to derive market areas for the three centers. Spatial distribution of resident population necessarily results in a locational site advantage for business purposes since businesses depend on various segments of the total population for their "raison d'être." From the business point of view, this population, with its various characteristics, makes up the potential customers that will measure possible success. The market area encompasses the customer's base of consumption or place of residence.

Land value measurement used in this study is based on consumer spending and the location of the consumer population of the three centers. This measurement is compared with the present assessed valuations on file in the Assessor's department of the city.

The comparison of business land values shows the two outlying centers assessed at a much lower rate than the

Downtown when the volume of business, number of customers, and market areas are evaluated.

Microfilm \$2.50; Xerox \$6.80. 141 pages.

#### A PRELIMINARY STATISTICAL INVESTIGATION ON THE RAINFALL OF JAVA

(L. C. Card No. Mic 60-4725)

I. Made Sandy, Ph.D.  
Clark University, 1960

Supervisor: Samuel Van Valkenburg

In this dissertation an attempt is made to study the variability of the rainfall of Java. After carefully examining the available data, 94 stations were chosen for the purpose. The choice is based on the fact that no serious breaks should exist in the data, besides the fact that they should cover the area homogeneously.

Only data for the period 1920-1943 are used, since they are the most reliable. In order to make a comparative study possible, the data should necessarily be of equal length.

The test of Abbe was used to check the homogeneity of several pairs of stations.

The most important climatic controls, the wind systems and relief are reviewed briefly. The monsoon winds, the most important precipitation agents, are variable winds. They are not persistent throughout the respective seasons, but their strength and direction change from time to time.

The contrast between the arrangement of the mountain ranges of west Java and that of east Java is clearly reflected in the amount and distribution of rainfall as depicted on the rainfall maps.

Several aspects of the basic characteristics of the rainfall of Java are also discussed. Three rainfall types have been proposed, in lieu of the 69 types used by Boerema. The distribution of the rainfall maxima and minima for most of the stations throughout the year indicates that the rainfall on the island is caused by a similar air flow. Long periodic fluctuations of the rainfall of the island have been investigated by Schmidt-ten Hoopen and Schmidt. Our recent results for the period 1920-1943 fail to agree with results obtained by these two authors.

The climatic classifications proposed by Koppen, Thornthwaite, Mohr and Schmidt-Ferguson are discussed. A comparison of the criteria for classification by Mohr and Schmidt-Ferguson are made.

Unlike the Koppen way, in this study we assign different lengths to each season. For the rainy and dry seasons four months each are assigned and for the transitional periods, two months each. In most parts of Java the contribution of the dry season to the annual total of rainfall is significant and should not be ignored.

The soundness of the mean and median to represent the normal amount of rainfall has been tested. The mean values of annual rainfall for practically all of the stations are fairly representative and the same is true for the mean values of the rainy season months. The mean values of the dry season months, however, should be used with reservation, especially of those stations located on the eastern part of the island.

Three variability indexes are used in this study. The Coefficient of Variation and the Intersequential Variability are used to express the variability of annual rainfall. The monthly variability is expressed by means of the Intersequential Variability only. The Average Variability is used to study the variability anomalies according to the corrected procedures of Conrad.

High rainfall variability is found in both the dry and wet areas of the island. High positive or negative anomalies are not confined to a "particular" area, but can be traced in both wet and dry regions.

We need more synoptic meteorological data of this part of the world in order to understand the intricacies of the climatic phenomena as they are observed today.

Microfilm \$2.50; Xerox \$8.60. 190 pages.

#### AN ANALYSIS OF GROCERY STORE LOCATIONS IN DES MOINES, IOWA, 1958.

(L. C. Card No. Mic 60-5700)

Howard Andrew Stafford, Jr., Ph.D.  
State University of Iowa, 1960

Chairman: Assistant Professor Edwin N. Thomas

This investigation attempts to assess the nature of the grocery store locational pattern in Des Moines, Iowa, in the year 1958, and to evaluate the effect of certain variables on that pattern. A map of grocery store locations reveals that the stores are not uniformly distributed over the city. The problem, then, is to account for these variations from uniformity by the concomitant variations of other variables which are thought to be associated with the dependent variable.

Objective, verifiable results have been obtained through the use of correlation and regression techniques. In order that these techniques could be employed, it was necessary that data be collected from standard statistical areas. Census tracts were chosen as the best units from which to gather data. Therefore, the problem has been operationally stated as an analysis of the spatial variations in the total number of grocery stores per census tract within the 1958 political limits of Des Moines, Iowa.

Seven independent variables have been hypothesized as having logical spatial relationships with the dependent variable. The relationships which have been proposed are that the number of grocery stores per tract will vary: (1) directly with the population of a tract; (2) directly with the number of dwelling units per tract; (3) inversely with the average value of single family dwelling units per tract; (4) directly with the total area in commercial land use per tract; (5) directly with the amount of residential area per tract; (6) inversely with the mean size of grocery store per tract; and (7) directly with the relative accessibility of each tract (as measured by automobile traffic flow).

Multiple correlation and regression analysis has been conducted to determine the adequacy of the independent variables to explain statistically the distribution of grocery stores by census tracts. Three variables remain signifi-

cant in combination, producing a multiple correlation coefficient of  $R = 0.716$ . The resultant regression equation is capable of accurate enough estimations to reduce the standard error of estimate to 2.58 as compared to the standard deviation of the dependent variable of 3.71. The three variables which remain significant in the multiple regression model are: (1) population, (2) mean value of dwelling units, and (3) mean size of grocery store.

An additional hypothesis which has been advanced, but not tested, is that the number of stores is inversely associated with the rate of growth of a tract, possibly reflecting the inertia which is thought to effect store locations. The possible influence of zoning restrictions on the location of grocery stores has been considered. The change in grocery retailing from a convenience function to a shopping function, and the attendant impact on store locations has been speculated upon.

This investigation indicates that in order to predict the number of grocery stores per statistical area most accurately, three factors should be taken into consideration. These three variables are: (1) population per statistical unit; (2) mean value of dwelling units (as a measure of income); and (3) mean size of grocery store. The significance of these three factors lends substantiation to the notion that grocery retailing is a convenience function which serves the general public.

The fact that little more than one half the spatial variations in the dependent variable can be explained by variations in the above mentioned independent variables reveals that a highly precise explanation of the distribution of the dependent variable is a far more complex goal than ordinarily supposed. The three most promising areas for further research seem to be: (1) the introduction of new independent variables; (2) more accurate measurement of variables and a reconsideration of the basic statistical units to be used in the collection of data; and (3) investigations conducted in urban areas other than Des Moines, and at times other than 1958.

Microfilm \$2.50; Xerox \$4.00. 73 pages.

#### THE REGIONAL MORPHOLOGICAL CHARACTER OF NEW ENGLAND MOUNTAINS

(L. C. Card No. Mic 60-4729)

Will Francis Thompson, Ph.D.  
Clark University, 1960

Supervisor: Richard J. Longee

Clima-geomorphic description of the Presidential Range in New Hampshire and Mount Katahdin in Maine, which are representative of the higher mountains in the northeastern United States and adjacent Canadian territory, has been undertaken to determine the value of such an approach to the climatic regionalization of mountains. Climatic factors are believed to be a major cause of regional homogeneity and regional differentiation in mountains, acting in large part through the climate-controlled geomorphic processes which sculpture mountainsides. Study of clima-geomorphic processes in the mountains of New England is appropriate because, though their climate



is known to be exceptionally severe, widely accepted geomorphic studies of them recognize only minimal response to climate.

Permafrost is shown to be more prevalent on New England mountains than has previously been believed. In this study an analysis of the nature of felsenmeer is made and the upland felsenmeers of New England are shown to be undergoing effective mass wasting, camouflaged by apparent stability (relative to one another) of surface boulders. Other forms of geomorphic response to climate in alpine and subalpine New England are described, including recently vanished post-continental alpine glaciers in many cirques, various kinds of active and inactive rock glaciers, pro-talus moats and ridges, fluvial erosion under special conditions above and below timberline, and very active riving of alpine bedrock outcrops.

Comparison with similar topography in the Rockies which was never glaciated indicates that New England alpine and subalpine morphology is the work of processes currently or very recently active in both regions. Since the total work done by such processes is very large in both instances, but in New England has made little progress since continental glaciation, it is believed that such processes were active on New England mountains for a very long time prior to such glaciation and that continental glaciation was an incident, rather than a dominant factor, in the development of the alpine and subalpine morphology characteristic of the region.

Field observations and information from the literature on the prevalence and effect of altitudinal differentiation of geomorphic processes elsewhere in the world are discussed. Landforms due to such differentiation (alp slopes, "summit surfaces," etc.) are shown to be widely prevalent, varying in aspect according to the nature of regional climates. A detailed photointerpretive survey of the Presidentials and Katahdin serves both to support the process-descriptions cited above and as a basis for clima-geomorphic comparisons between New England mountains and mountains elsewhere.

Microfilm \$3.40; Xerox \$11.95. 262 pages.

## AN ANALYSIS OF THE SPACING OF SMALL TOWNS IN IOWA

(L. C. Card No. Mic 60-5703)

George Vuicich, Ph.D.  
State University of Iowa, 1960

Chairman: Dr. Edwin N. Thomas

As members of a mature science, geographers are striving to develop comprehensive theories which will account for or explain the varying distributions of space-occupying phenomena. Urban geographers' efforts to develop a theory which will account for the spatial distributions of urban places have culminated in what has become known as central place theory.

The object of this investigation is to test selected aspects of central place theory utilizing a sample of small towns in Iowa. Eight hypotheses, whose supporting rationale reflects basic assumptions and conditions assumed to be operating according to the central place theory, are tendered and tested using simple and multiple linear regression and correlation analyses.

Initial statistical tests of the proposed model suggest a revision in the dependent variable. The revision requires minor modification in the rationale supporting the model. The original hypotheses remain logically tenable.

The results of subsequent statistical tests involving the revised model are disappointing. One of the eight hypotheses is verified by the tests. Efforts to improve the results through further statistical tests prove futile.

It is felt that the results do not warrant rejecting the notions supporting central place theory. Rather, it is concluded that improved operational definitions of some of the variables, further refinement of the data, improved statistical tests as well as the identification of a suspected random error variable could improve the model significantly and support existing theory relative to the spatial distribution of urban places.

Microfilm \$2.50; Xerox \$4.20. 78 pages.

## GEOLOGY

### EXPERIMENTAL STUDIES BEARING ON THE ORIGIN OF PSEUDOLEUCITE AND ASSOCIATED PROBLEMS OF ALKALINE ROCK SYSTEMS

(L. C. Card No. Mic 60-5433)

Robert F. Fudali, Ph.D.  
The Pennsylvania State University, 1960

Selected parts of the system nepheline-kalsilite-silica-water were studied at elevated temperatures and, for the most part, at a  $P_{H_2O}$  of 1000 kg/cm<sup>2</sup>. Experimental work also was carried out with natural specimens of leucite and pseudoleucite. Both equilibrium and kinetic phenomena were studied by the quench method. The liquidus of the isobaric section through the quaternary system

( $P_{H_2O}$  = 1000 kg/cm<sup>2</sup>) is substantially lower than in the dry system and the primary field of leucite is considerably restricted. There is a minimum on the nepheline-sanidine field boundary and a peritectic point at the junction of the three field boundaries nepheline-sanidine, nepheline-leucite, and sanidine-leucite. Leucite solid solution extends to a maximum of ~40 wt % NaAlSi<sub>2</sub>O<sub>6</sub> at low water vapor pressures. Soda-rich leucite becomes unstable and breaks down to nepheline and sanidine as the temperature falls. The leucite solid solutions become unstable at higher temperatures as the sodium content increases. Kinetic studies indicate that if the soda content is high enough, it is impossible to prevent the breakdown of these solid solutions in an extrusive rock. This subsolidus breakdown is responsible for the formation of pseudoleucite. Unaltered, natural specimens of pseudoleucite

were reconverted to leucite under appropriate PT conditions. Sodic leucite and pseudoleucite are not commonly found in extrusive rocks because the majority of extrusives which contain leucite have low  $\text{Na}_2\text{O}$  contents, and/or were extruded at too high a temperature for significant leucite solid solution to develop. The ideal host rock for the development and preservation of pseudoleucite is a high-sodium phonolite. The stability field of analcite and the extent of potash substitution were studied at a  $P_{\text{H}_2\text{O}}$  of 4000 kg/cm<sup>2</sup>. The results show primary analcite must crystallize very late in the magmatic sequence and potash substitution is very limited. The formation of pseudoleucite from the breakdown of a potash-rich analcite is highly improbable. Equilibrium, fractional, and magmatic crystallization in the system are discussed on the basis of isothermal, isobaric sections. The importance of the incongruent melting of potash feldspar and reactions at the peritectic R have been overestimated. Most plutonic alkaline rocks whose compositions lie in the primary field of leucite and which consist essentially of nepheline and sanidine attain this final crystalline assemblage through the subsolidus breakdown of soda-rich leucite.

Microfilm \$2.50; Xerox \$6.00. 125 pages.

#### SILICA BEHAVIOR IN AGGREGATES AND CONCRETE

(L. C. Card No. Mic 60-4897)

Carl Lee Roy Hiltrop, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisors: John Lemish and  
Fredrick Duke

The work was carried on as part of a research program sponsored by the Highway Commission of the state of Iowa. The purpose of the program is to delineate those properties of a carbonate rock which are factors in determining whether or not that rock will serve satisfactorily as coarse aggregate when mixed with Portland cement in the construction of concrete highways.

A large part of the earlier work had been devoted to sampling and analyzing the "reaction shells" which had been observed to grow in the peripheral zone of inferior aggregates as a result of reaction between the rock and cement paste.

As a result of earlier work, two theories had been proposed to explain the growth of reaction shells. The first theory proposed that all reaction shells grew as a result of the rock having absorbed "mobile" silicate ion from the cement paste. The silicate ion was theorized to undergo a condensation polymerization with reactive functional groups on the clay impurity in the carbonate rock. The second theory proposed that, dependent upon the relative concentration of mobile silicate in the rock and in the cement paste, reaction shells could grow by two mechanisms. The first possibility was essentially as outlined above. The second stated: if mobile silicate were more abundant in the rock than in the cement paste, the rock would supply silicate to the paste. In the process, silicate in the shell zone would become rearranged with resultant formation of the acid insoluble reaction shell.

In order to study the mobility and direction of movement of silicate ion in shell growth, 100 gram samples of two different carbonate rocks were selected. The first rock is considered to grow a reaction shell by adsorption of silicate; the second was believed to grow a reaction shell by rearrangement of silicate already present, with subsequent loss of silicate to the cement paste. These samples, as well as samples of three standard cements, each of different alkali content, were refluxed in distilled water for 48 hours.

The glass refluxers had been found to contribute about 200 mg. of silicon per liter of solution; 100% being molybdate reactive. Above the first rock, about 130 mg. of silicon per liter of solution was found; 95% being molybdate reactive. Above the second rock, about 16 mg. of silicon was found per liter of solution; 95% being molybdate reactive. Above each of the cements, about 3 mg. of silicon per liter was found; 50% being molybdate reactive.

The reflux experiments show that in this environment, which is high in silicate, reaction shells can be grown in a few days rather than in months, as required by other methods. Also, that cement has the capability to "fix" mobile silicate under the refluxing conditions. Also, that the second rock, under these conditions, had a greater tendency to "fix" mobile silicate than did the former.

In the second section of the present work, the author describes the treatment of various carbonate rock specimens with vapors of tetrachlorosilane as well as with mixtures of vapors of methyltrichlorosilane and dimethyldichlorosilane. Treatment of rocks with these materials resulted in products which appear to corroborate the theory of shell growth by absorption of silicate. Also, the products might have a practical use. It was shown that inferior aggregate, thus treated, had been benefited. For example, loss by freezing and thawing had been decreased by as much as 22% in some specimens.

Microfilm \$2.50; Xerox \$5.20. 104 pages.

#### GEOLOGY OF WESTERN LOUISA COUNTY, VIRGINIA.

(L. C. Card No. Mic 60-6503)

Henry Robert Hopkins, Ph.D.

Cornell University, 1960

Precambrian and Lower Cambrian to Lower Ordovician sedimentary rocks in the Piedmont Province have been deformed, metamorphosed to the greenschist facies and intruded by diorite, granodiorite, and few basic to acidic dikes.

Five units were mapped in the area, and are, from oldest to youngest, Lynchburg formation, Catoclin greenstone, Rivanna formation, Keswick formation and Boyd Tavern formation. The sedimentary rocks were deposited in a eugeosynclinal environment. The sequence of deposition is broken by a Precambrian-Cambrian unconformity and a Middle Cambrian unconformity. Following the Middle Cambrian unconformity the source of the sediments changed from west to the east.

All of the metasedimentary rocks were isoclinally folded and the folds overturned to the northwest by a major deformation of probable Mississippian age. A later mild



deformation, near the end of the Paleozoic, formed the three major structural features of the area, the James River synclinorium, the Zion anticlinorium, and the Louisa synclinorium.

During the major deformation, or immediately following it, the Green Springs diorite and Ellisville granodiorite were intruded into the metasedimentary rocks. Following these major intrusions, felsite, hornblende gabbro, diabase and alsakite dikes were intruded.

Three deposits of talc of possible commercial importance occur within the area, and small-plate vermiculite is present in large quantities in the Green Springs intrusive. One minor sulfide gossan and a residual manganese deposit may be of economic value.

Microfilm \$2.50; Xerox \$6.60. 140 pages.

# THE GEOLOGY OF THE SEQUATCHIE VALLEY OVERTHRUST BLOCK, SEQUATCHIE VALLEY, TENNESSEE.

(L. C. Card No. Mic 60-4677)

Robert Calvin Milici, Ph.D.  
The University of Tennessee, 1960

Major Professor: George D. Swingle

Detailed geologic mapping of the Sequatchie Valley fault, Sequatchie Valley, Tennessee, has indicated that the Sequatchie Valley fault generally dips to the southeast at a low angle in the northern part of the valley, at a moderate angle in the central portion, and at a low angle in the southern portion of the area mapped, near the Tennessee-Alabama state line. The low angle nature of the overthrust is evidenced by the irregular trace of the fault and klippen immediately in front of the overthrust block in the northern and southern portions of the valley. The trace of the Sequatchie Valley fault is straighter, and klippen are absent in the central portion of the area mapped.

Rock units mapped by the writer are: the upper 1000 to 1500 feet of the Knox group; 1500 feet of thin- and thick-bedded Ordovician limestones; 30 to 130 feet of Rockwood formation of Silurian age; 10 to 35 feet of Devonian-Mississippian (Chattanooga) shale; 1200 feet of limestones and fine-grained clastics of Mississippian age; and 300 to 400 feet of Pennsylvanian shales and sandstones.

In the northern and southern portions of the area mapped, Ordovician to Mississippian carbonates are thrust over Mississippian shales. In the central portion, Ordovician carbonates are thrust over massive limestones of Mississippian age.

The lithology of the footwall is apparently the factor which governs the attitude of the fault surface.

Microfilm \$2.50; Xerox \$7.40. 156 pages.

# PHASE RELATIONS IN THE $Mg_2SiO_4$ - $CaAl_2Si_2O_8$ - $FeO$ - $Fe_2O_3$ - $SiO_2$ SYSTEM AND THEIR BEARING ON CRYSTALLIZATION OF BASALTIC MAGMA

(L. C. Card No. Mic 60-5454)

Peter L. Roeder, Ph.D.  
The Pennsylvania State University, 1960

The effect of the oxygen partial pressure ( $P_{O_2}$ ) in iron-oxide systems is summarized with particular emphasis on paths of equilibrium and fractional crystallization. The previous work on the  $MgO$ - $FeO$ - $Fe_2O_3$ - $SiO_2$  system and its application to crystallization of a basaltic liquid is also reviewed.

Phase-equilibria data are presented for the  $Mg_2SiO_4$ - $CaAl_2Si_2O_8$ - $FeO$ - $Fe_2O_3$ - $SiO_2$  system at the constant  $P_{O_2}$  of air. An isobaric tetrahedron is used for representation of the liquidus data. Three isobaric "invariant" points were found within the system. These points deviate slightly from invariant behavior mainly because of solid solution of  $Al_2O_3$  in hematite and magnetite. The amount of deviation is small for geologically important mixtures because of the small amount of magnetite and hematite present in these mixtures. Information obtained on the composition of the crystalline phases in the system is presented.

All mixtures in this system when fractionally crystallized in air will have a last liquid composition close to that of a simplified andesite (in weight per cent  $SiO_2=57$ ,  $Al_2O_3=17$ ,  $CaO=9$ ,  $MgO=9$ , iron oxide=8). A liquid variation diagram of a simplified basaltic mixture in the system is presented. This indicates that fractional crystallization in air of a simplified basalt or peridotite produces liquids enriched in  $SiO_2$  relative to  $MgO$  and iron oxide.  $CaO$  and  $Al_2O_3$  increase to values similar to those found in andesites and dacites of the calc-alkali lava series.

Theoretical considerations indicate that fractional crystallization of a simplified basalt at low partial pressures of oxygen will produce iron oxide enrichment relative to  $SiO_2$  and  $MgO$ . Applications of these principles to crystallization of the Skaergaard intrusion are discussed.

Microfilm \$2.50; Xerox \$5.60. 111 pages.

# MIDDLE ORDOVICIAN STRATIGRAPHY OF THE RED MOUNTAIN AREA, ALABAMA.

(L. C. Card No. Mic 60-4865)

Wiley S. Rogers, III, Ph.D.  
The University of North Carolina, 1960

Supervisor: Dr. Walter H. Wheeler

The Chickamauga "limestone" (Middle Ordovician) in Alabama may be divided into four units which correlate well with sections previously studied in adjacent states. Detailed stratigraphic and lithologic studies of the existing outcrops in the Red Mountain area have been made. These studies have been integrated with the more recently published data on the Middle Ordovician of the southern and east-central United States, and a synthesis has been developed.

That section of predominantly Middle Ordovician strata in Alabama and southern Tennessee lying between the uppermost members of the Knox group and the base of the Red Mountain formation should be called the Chickamauga group rather than the Chickamauga "limestone." The group is composed of the lithostratigraphic units herein designated as Unit I, Unit II, Unit III, and Unit IV, in ascending order. Gross correlation of these units is suggested with units 1, 2, 3, and 4 as erected by John Rodgers in eastern Tennessee. In addition, Unit I is Chazy in age and is correlated with the Five Oaks and Lenoir limestones of Virginia and Tennessee and the Lenoir limestone of Cahaba Valley, Alabama. Units II and III are Black River in age and correlate with the Stones River Group of the Central Basin of Tennessee and the Little Oak limestone-Athens shale sequence of Cahaba Valley, Alabama. Unit IV correlates with the Hermitage formation of the Central Basin of Tennessee and with the Martinsburg shale of Tennessee and Virginia, and is of Trenton age.

In the area investigated, the Chickamauga group lies directly on representatives of the Knox group or is separated from these representatives by the Attalla chert conglomerate. In many areas, the basal strata of the Chickamauga group is a dense, fine-grained limestone. In others, progressively toward the northeastern extent of the area, the limestone is replaced by red to tan shale. In most areas, the lower contact is readily determinable.

The upper contact of the Chickamauga group is generally well-marked by the Red Mountain formation which lies unconformably upon it. In general, in the area studied, from northeast to southwest, the Red Mountain formation lies on progressively older sections of the Chickamauga group.

The Chickamauga group in Alabama lies within the Tennessee "basin" which includes an area from Gadsden, Alabama, to a point just north of Staunton, Virginia. Western extension of this "basin" includes the Central Basin portion of central Tennessee. A positive area (the Blount Mountains) existed in western North Carolina during a major portion of the epoch. The resulting clastic wedge, called Blount Delta by others, is recognized in Alabama. The incursion of the clastic wedge into the basin resulted in a gradual westward replacement of limestones by shales. Thus, the Chickamauga group, as exposed in Jones Valley and its northern extensions, is composed of two major lithofacies, a southwestern non-clastic facies and a northeastern clastic facies. Strata in Cahaba Valley, of lower Middle Ordovician age, are continuations of the northeastern clastic facies.

A heretofore unrecognized structure, the Birmingham thrust fault, has compounded the stratigraphic complexities in Jones Valley. Its stratigraphic position ranges from Unit I of the Chickamauga group to the Red Mountain formation. Microfilm \$4.20; Xerox \$14.85. 327 pages.

SUBSOLIDUS STUDIES IN  
THE SYSTEM  $\text{CaCO}_3$ - $\text{MgCO}_3$ - $\text{FeCO}_3$ - $\text{MnCO}_3$   
(L. C. Card No. Mic 60-5455)

Philip E. Rosenberg, Ph.D.  
The Pennsylvania State University, 1960

Since the most important rock-forming carbonates in the quaternary system  $\text{CaCO}_3$ - $\text{MgCO}_3$ - $\text{FeCO}_3$ - $\text{MnCO}_3$ , a limited investigation of this system was undertaken as a contribution to carbonate petrology. Phase equilibrium studies were undertaken in the temperature range 350°-550°C at  $\text{CO}_2$  (+CO) pressures as high as 60,000 p.s.i. Starting materials were packed in gold foil envelopes to which a drop of dilute alkali-carbonate solution was added to promote reaction. The products were examined by standard x-ray diffraction and optical methods. The relationship between  $\Delta 2\theta$  (2 $\theta$  carbonate (211) - 2 $\theta$  standard) and composition was used to determine the nature and extent of solid solution.

A limited series of solid solutions was obtained in the system  $\text{CaCO}_3$ - $\text{FeCO}_3$ , but the iron analogue of dolomite, ferrodolomite, was not synthesized. At 450°C the extent of solubility of  $\text{Fe}^{++}$  in calcite was 10 mole % while  $\text{Ca}^{++}$  in siderite was 4 mole %. At 550°C these solubilities are 18 mole % and 4 mole %, respectively. A complete series of apparently ideal solid solutions was observed in the system  $\text{MgCO}_3$ - $\text{FeCO}_3$  at temperatures as low as 295°C.

Isotherms were determined in the system  $\text{CaCO}_3$ - $\text{MgCO}_3$ - $\text{FeCO}_3$  at 400°C, 450°C, and 500°C. The phase areas encountered along the join  $\text{CaMg}(\text{CO}_3)_2$ - $\text{CaFe}(\text{CO}_3)_2$  were: A one-phase area of dolomite-ankerite, a two-phase area of ankerite + siderite-magnesite solid solution, a three-phase area of ankerite + siderite-magnesite solid solution + calcite solid solution, and a two-phase area of calcite solid solution + siderite solid solution. The one-phase area extends from dolomite to 65 mole % ferrodolomite and the three-phase area from 75 to 85 mole % ferrodolomite at 450°C. Ordering was observed in all members of the dolomite-ankerite series. Ferrodolomite was not a stable phase within the P-T range of this investigation. The close similarity between the compositions of natural carbonates, estimated by measurement of refractive index (No) and  $\Delta 2\theta$ , and the synthetic carbonates in the system  $\text{CaCO}_3$ - $\text{MgCO}_3$ - $\text{FeCO}_3$  suggest that the experimental results will find direct application in carbonate mineralogy and petrology.

A complete series of solid solutions was obtained in the systems  $\text{FeCO}_3$ - $\text{MnCO}_3$  and  $\text{CaMg}(\text{CO}_3)_2$ - $\text{CaMn}(\text{CO}_3)_2$  at 450°C, but in the system  $\text{CaFe}(\text{CO}_3)_2$ - $\text{CaMn}(\text{CO}_3)_2$  an extensive two-phase area exists at this temperature. The one-phase area, however, expands rapidly with increasing temperature and should predominate at 550°C. The phase areas in the system  $\text{CaMg}(\text{CO}_3)_2$ - $\text{CaFe}(\text{CO}_3)_2$ - $\text{CaMn}(\text{CO}_3)_2$  are Mn-rich extensions of those along the join  $\text{CaMg}(\text{CO}_3)_2$ - $\text{CaFe}(\text{CO}_3)_2$ .

A preliminary diagram of the system  $\text{CaCO}_3$ - $\text{MgCO}_3$ - $\text{FeCO}_3$ - $\text{MnCO}_3$  at 450°C has been constructed, based on present investigations, on data from the literature, and on hypothetical phase relations. Since the five phase-volumes encountered in the quaternary system are all represented in the system  $\text{CaCO}_3$ - $\text{MgCO}_3$ - $\text{FeCO}_3$ , this system may be used as a reference in naming these volumes. The three-phase space of ankerite + calcite solid solution + siderite-magnesite solid solution extends no further than 40 mole %  $\text{MnCO}_3$ . The two-phase volumes involve equilibria with



the dolomite-ankerite series. The extent of these in the four-component system is similar to that of the three-phase space. The remaining two-phase space, calcite solid solution + siderite solid solution extends into the Mn-rich portion of the system where it occupies a considerable volume. The single, one-phase space is represented in every ternary system and is extremely variable in composition.

The suggested applications of these studies to carbonate mineralogy and petrology included the possible development of a carbonate geothermometer and criteria for the recognition of equilibrium in natural carbonate assemblages.

Microfilm \$2.50; Xerox \$7.00. 146 pages.

#### TRANSVERSE DISPERSION IN LIQUID FLOW THROUGH POROUS MEDIA

(L. C. Card No. Mic 60-5109)

Eugene S. Simpson, Ph.D.  
Columbia University, 1960

It is assumed that a line source of tracer elements exists in a porous medium through which an incompressible fluid is flowing. Each tracer element is assumed to: (a) be completely miscible in the fluid; (b) be unaffected by the solid medium or by any other tracer element, and (c) have a path dependent both on the motion of the fluid and on its own molecular diffusivity. As the tracer elements move away from the source they will disperse. A mathematical model, describing the dispersion transverse to the direction of bulk flow is formulated under the following assumptions: (a) each path has an average direction parallel to the direction of bulk flow and herein termed "zero circuitry"; and (b) tracer elements may transfer from one flow path to another by virtue of the molecular diffusivity of the elements. It is then found that the standard deviation of the dispersion is proportional to the square root of the product of grain size, length of flow, and probability that a tracer element will transfer from one flow line to another in a given unit distance. An estimate of the probability is obtained by equating it to that fraction of a large number of tracer elements that would diffuse across the center-line of an idealized pore space. The fraction will depend on: (a) size of pore space; (b) velocity of fluid; and (c) coefficient of diffusivity of tracer elements.

A curve is plotted giving the relation between a dimensionless parameter,  $\sigma^*$ , which is a measure of the dispersion in a given medium, and a dimensionless parameter,  $H^*$ , which is a measure of fluid velocity and tracer-element diffusivity in the same medium. It is predicted that, within the range of Darcy's law, as velocity increases dispersion decreases.

A series of laboratory experiments designed to measure transverse dispersion in a relatively homogeneous medium, and performed in the range of Reynolds number from 0.04 (approx.) to 1.0 (approx.), showed that as velocity increased dispersion decreased. The measured standard deviation of the dispersion ranged from 1.57 cm to 0.89 cm (with some scatter) in a bulk flow distance of 119 cm, and the individual concentration distributions were found to be normal except near the end points.

Experimental data were reduced to dimensionless form by assigning an intuitively reasonable value to a dimensionless constant, and in this way the measured dispersion is found to be roughly double that predicted by theory. By analysis of other possible mechanisms of dispersion it is concluded that the observed dispersion is best explained by assuming that a velocity-dependent dispersion (as predicted by theory) is superposed on a constant dispersion, independent of velocity, which results from wandering of stream paths (i.e., non-zero circuitry).

Finally, it is shown that at very low fluid velocity ( $R < 0.005$  for the experimental porous medium), the effect of molecular diffusivity of the tracer elements overshadows the effects of other possible mechanisms causing dispersion. However, it is believed that dispersion caused by non-zero circuitry increases with medium inhomogeneity. The experimental medium was relatively homogeneous; hence, the relationship between non-zero circuitry and medium inhomogeneity (as it occurs in most natural aquifers) remains to be investigated.

Microfilm \$2.50; Xerox \$5.60. 113 pages.

#### UPPER CRETACEOUS AND LOWER TERTIARY SPOROMORPHAE FROM NORTHWESTERN SOUTH DAKOTA

(L. C. Card No. Mic 60-5461)

Edward Alexander Stanley, Ph.D.  
The Pennsylvania State University, 1960

Palynological studies of the upper Cretaceous and lower Tertiary sediments exposed at three buttes in northwestern Harding County, South Dakota have been undertaken in order to establish a zonation of these sediments which, in turn, will serve to provide a means of correlating the continental sediments within the area. Descriptions and illustrations are given for 106 species, 3 subspecies and 49 genera from the upper Cretaceous Hell Creek and Lower Paleocene Fort Union strata. In addition, the botanical affinities of the described genera are briefly discussed. Six genera, 73 species and 1 subspecies are thought to be new. Stratigraphic sections of the three buttes are described and a species distribution table provided in order to give detailed information concerning the sporomorphae occurrence.

Crow Butte, containing sediments of late Cretaceous age, and North Cave Hills Butte, containing sediments of early Tertiary age, each are divided into three zones based on the sporomorphae occurrence. These two buttes have approximately 12% of their sporomorph species in common indicating that the upper Cretaceous and lower Tertiary sediments can be differentiated on the bases of palynological investigation. Twin Butte, which is thought by many to contain the Cretaceous-Tertiary boundary is shown to be correlative with the middle zone of the North Cave Hills Butte suggesting a younger age than was formerly believed.

The following genera are thought to be new: Grani-sporites, Kyrtomisorites, Wodehouseia, Pseudotricolpites, Tetracolpites and Trilobopollenites. New species are: Cingulatisporites dakotaensis, C. radiatus, Foveotrilletes conatus, Gleicheniidites triangularis, Granisorites

granulatus, Hymenophyllumsporites tenuexinuous, Leptolepidites pseudoverrucatus, L. tumeus, Lycopodiacidites aliquantulus, L. amplexus, L. tenuangulus, Neoraistrickia folliculus, Peromonoletes cristatus, Reticuloidosporites reticulatus, Extratropopollenites striatus, Intratropopollenites despersio, Momipites completus, M. findus, M. incompletus, Proteacidites atriatus, P. auricularis, Triatriopollenites cretaciis, T. exigius, T. granilabratus, T. quasitipicus, T. superficialis, Tropopollenites endoplicatus, Analcolosidites rotundus, Multiporopollenites ludowensis, Polyporopollenites atriatus, P. concavus, Wodehouseia fimbriatus, W. spinatus, Cupanieidites speciosus, Tricolporopollenites brevicornulus, T. circularis, T. cretaciis, T. globus, T. problematicus,

T. striatus, T. tectatus, T. vulvatus, Cycadopites giganticus, Monosulcites nodulus, M. scabratus, Pseudotricolpites clavatus, Quercoidites genistriatus, Tricolpites barathrum, T. psilatus, T. varius, Tricolpopollenites apertus, T. exinuous, T. glomerosus, T. macroclavatus, T. micratus, T. microclavatus, T. pseudomaturensis, T. trilobatus, Tetracolpites quadratus, Aquilapollenites delicatus, A. pacyexinuous, Schizosporis duplibacularius, S. scabratus, Trilobopollenites reticulatus, T. striatus, Abietineaepollenites angustistrigis, A. hesperensis, A. latistrigis, Cedripites paleocenicus, Pinuspollenites longus, P. similis, Podocarpidites maximus, Tetradites pseudoericus. The new subspecies is Tricolporopollenites kruschi triangularis.

Microfilm \$4.60; Xerox \$16.20. 358 pages.

## HEALTH SCIENCES

## HEALTH SCIENCES, GENERAL

A COMPARISON OF CONTROLS  
AS FOUND IN HOSPITALS WITH THOSE  
IN INDUSTRIES CLASSIFIED  
AS PUBLIC UTILITIES

(L. C. Card No. Mic 60-5649)

Sam Allen Edwards, Ph.D.  
State University of Iowa, 1960

Chairman: Professor Leon Gintzig

As the social and economic importance of hospitals has grown, a seemingly concomitant development has occurred in controls applicable to hospitals. The extent of these controls, combined with the magnitude of the social importance of hospital functions, raises the questions of whether hospitals should be placed in a public utility status and whether the major regulation of hospitals by informal controls represents a long-run policy capable of assuring the attainment of the proper social objective and its acceptance by the public.

In an attempt to answer these questions, the following determinations and analyses were made:

1. Determination of the hospital organizational complex.
2. Establishment of the comparative position of hospitals with regard to governmental controls by comparing them to industries classified as public utilities.
3. A philosophy of social control in contemporary society.
4. Analysis of the current balance between governmental and informal controls.

Based on these determinations and analyses, it was found that the extent of governmental control of hospitals has developed at an increasing rate since 1952 until it approximates the control exercised by governments over public utilities. This increase in governmental controls is indirect and has developed from the authority most state insurance commissioners have over Blue Cross plans. It has been formalized by administrative decree rather

than by new legislation. Currently this control extends, for all practical purposes, to financing, rates, and services of hospitals. It is concluded that, while hospitals are not public utilities in the normally accepted sense, they are, for sufficient reason, subject to control for the public good.

It was also concluded that the major regulation of hospitals by informal controls represents a long-run policy capable of assuring the attainment of the proper social objective and its acceptance by the public. This conclusion was based on the determination that hospitals are other than ordinary businesses and deserve special consideration as special enterprises. The non-profit nature of hospitals, the magnitude of social importance of hospital functions, the guidance of hospitals by non-paid representatives of the community, and the development of an acceptable self-governing system were important considerations in the establishment of this special category. It was concluded that this special consideration was currently endangered by lack of enforcement of certain important standards and lack of understanding by the public of the nature of hospital governing bodies.

Microfilm \$4.50; Xerox \$16.00. 352 pages.

AN APPRAISAL OF HEALTH INSTRUCTION  
IN SELECTED SECONDARY SCHOOLS  
OF MINNESOTA UNDER  
THREE PLANS OF SCHEDULING

(L. C. Card No. Mic 60-6339)

James Harold Witham, H.S.D.  
Indiana University, 1960

Chairman: Dr. J. Keogh Rash

Problem

The problem of this study was to determine the comparative contributions of health instruction to health knowledge under three plans of scheduling as measured by



Kilander's Health Knowledge Test Form AM at the completion of the high school education in selected Minnesota Public High Schools.

#### Procedures

It was recommended that 20 schools from each of the three populations teaching health education under scheduling Plans I, II, and III would be a representative sample. Permission was obtained to administer a health knowledge test to senior pupils in the 60 randomly selected public high schools in Minnesota.

The Otis score card for evaluating standardized tests was used to select the best health knowledge tests. A curricular analysis was then made of standardized health knowledge tests developed by Bridges, Dearborn, and Kilander using the Minnesota State Course of Study as the criterion measure to compare closeness of fit on test items and sections of the course of study. The Minnesota State Course of Study covered 97 per cent of the test items in the Kilander Health Knowledge Test Form AM. This test was superior to the other two in coverage in six of the 11 sections.

The Kilander Health Knowledge Test Form AM was used to test 2,785 pupils; 689 pupils who received direct instruction under Plan I in 20 schools; 1,201 pupils who received direct instruction combined with physical education under Plan II in 20 schools; and 895 pupils who received indirect instruction in related subject areas under Plan III in 20 schools.

The test administrators administered the tests in their schools under standardized conditions between April 15 and May 15, 1956. The completed tests were returned to the investigator for scoring. The mean score for each of the 60 randomly selected schools was calculated and recorded under Plans I, II, or III as the data to be evaluated.

The basic statistical technique utilized to compare the three sets of school means was the analysis of variance. The F-test, the chi square test, and the T-test were also utilized in analyzing the data. The five per cent level of confidence was accepted as the level which was indicative of significance.

#### Conclusions

The following conclusions seem to have implications for the three health instructional plans:

1. Direct instruction in the nature of a concentrated course for a period of one year was found to be the significantly superior instructional plan.
2. Indirect health instruction in related subject fields was found to be the least effective plan.
3. The health instructional plans from most to least effective were found to be: (a) direct instruction in a concentrated one-year course; (b) direct instruction alternating with physical education based on a definite number of periods per week; and (c) indirect instruction in related subject areas.
4. Teacher preparation did not appear to influence the superiority of Plan I over Plans II and III.

#### Recommendations

The following recommendations are presented:

1. It is recommended that senior high schools of Minnesota, as well as high schools of other states

where a plan of direct health instruction is not offered, should include a course in direct health instruction of at least one year in length in their curricula.

2. It is recommended that health teachers, local and state school health education supervisors, and school administrators who are presently providing health instruction in related subject areas or direct instruction in combination with physical education should incorporate a direct health instruction plan of one year's duration at the senior high school level to replace existing health scheduling plans.
3. Indirect instruction in related subject areas should be encouraged in the appropriate related subject areas. Microfilm \$2.50; Xerox \$5.40. 110 pages.

#### HEALTH SCIENCES, NUTRITION

##### COMPARATIVE METABOLIC RESPONSE TO ERYTHORBIC ACID AND ASCORBIC ACID BY THE HUMAN

(L. C. Card No. Mic 60-5464)

Marian M. Y. Wang, Ph.D.  
The Pennsylvania State University, 1960

The physiological response of human subjects to oral intakes of the isomers, erythorbic and L-ascorbic acids, was compared. The criteria were urinary return and plasma level of total ascorbic acid. Two load tests and a balance study were conducted.

Test loads of 165 mg and 250 mg were administered to six and five subjects, respectively, in the two load test studies. Blood plasma increments of total ascorbic acid were similar following either L-ascorbic acid or erythorbic acid test doses. Comparable plasma levels for the two forms of intake for three hours following ingestion were found for each load test study. In the balance study, six young male college students were maintained 14 days on a 25 mg ascorbic acid diet and four 12-day experimental periods on a 10 mg ascorbic acid diet. During four consecutive experimental periods, the two isomers were fed alternately as 100 mg supplements to a 10 mg ascorbic acid diet. A cross-over design of supplementation was used. Fasting blood samples were taken and 24-hour urinary collections were made on the last four days of each experimental period. With L-ascorbic acid supplementation, the mean fasting plasma total ascorbic acid level was 1.03 mg%; the mean urinary return 15.3 mg per day. For these same subjects on erythorbic acid supplementation, the mean fasting plasma level was 0.62 mg%; but the urinary returns were increased almost five-fold, 72.2 mg per day.

Erythorbic acid has little or no antiscorbutic activity. This may be because of preferential peripheral uptake of the vitamin or high excretion of erythorbic acid due to selective tubular reabsorption of the vitamin. An experiment was carried out to study the peripheral uptake and excretion rate of the two isomers.

Six male adult subjects were fed a 25 mg supplement to a 10 mg ascorbic acid diet during three 7-day experimental periods. Prior to the experimental period there was one week of adjustment, and two weeks of exploratory work when all the subjects had a daily dietary ascorbic acid intake of 10 mg. On the 5th day of each experimental period, a test dose of 300 mg erythorbic acid was given to the subjects; on the 7th day a test dose of the same amount of L-ascorbic acid was given.

The peripheral uptake was measured by determining the difference between the ascorbic acid levels in arterial and venous blood. Fasting capillary and venous blood samples were taken on the test days. The fasting sample was followed by a second sampling of capillary and venous blood after the ingestion of the test dose. No increase of arterio-venous difference occurred during the elevation of plasma total ascorbic acid on either form of test dose. The arterio-venous difference method did not differentiate between the peripheral uptake of the two isomers, but it revealed a small sustained L-ascorbic acid uptake.

Urinary collection was started after the ingestion of the test dose. The 24-hour collections divided into three periods were 32%, 12.6% and 9% of the erythorbic acid test dose; and 1.7%, 1.4% and 2.2% for the L-ascorbic acid test dose. Most of the erythorbic acid was excreted within the first six hours. The high and rapid erythorbic acid excretion suggests no appreciable reabsorption by the tubular cells.

Microfilm \$2.50; Xerox \$4.00. 75 pages.

#### HEALTH SCIENCES, PHARMACY

##### INTERACTION OF PHARMACEUTICALS WITH NONIONIC MACROMOLECULES.

(L. C. Card No. Mic 60-5637)

Sayed Sami Ahsan, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor Seymour M. Blaug

A solubility study has shown a definite complex formation between Tweens and o-hydroxybenzoic acid, p-hydroxybenzoic acid, acetylsalicylic acid and phenobarbital. No interaction was observed between the Tweens and boric acid and m-hydroxybenzoic acid. Among the hydroxybenzoic acids, the ortho isomer exhibited the strongest complexing tendency followed by the para and meta isomers. Since the molecular weights of the Tweens studied varied between a narrow range (1236-1328), the difference in complexing tendencies of the various Tweens was not highly significant. The extent to which aspirin, phenobarbital, o-hydroxybenzoic acid and p-hydroxybenzoic acid interacted with the Tweens was much greater than their reported interactions with polyethylene glycols 4000 and 6000.

Cloud point titration technique was employed to study the interaction of Tweens with phenol and resorcinol. Tweens, even in low concentrations, reacted with phenol and resorcinol to give water insoluble oily liquids.

The interaction of methyl, ethyl, propyl and butyl parabens with Tween 80, Myrj 52, Pluronic F-68 and

polyethylene glycols 4000 and 6000 was studied. The general binding tendency which the parabens exhibited increased with the molecular weight of the paraben. In other words, the strongest complexing tendency was exhibited by butyl paraben followed by propyl, ethyl and methyl parabens. The hydrophil-lipophil balance of the nonionic macromolecule strongly influenced the binding tendency which the parabens exhibited for the macromolecules. The extent of complex formation in solutions of strongly hydrophilic macromolecules such as polyethylene glycols 4000 and 6000 was relatively very small when compared to the binding affinity exhibited by the polyoxyethylene macromolecules, Tween 80 and Myrj 52.

The binding of preservatives by nonionic macromolecules reduces the amount of free preservative available to protect a pharmaceutical formulation against deterioration. Data presented enables one to calculate the amount of preservative that would be required in the presence of various nonionic macromolecules to insure the presence of sufficient unbound or free preservative.

The interaction of sorbic acid with various nonionic macromolecules was investigated. The effect of Tween 80 on the preservative action of sorbic acid was also studied to determine if any correlation exists between the degree of interaction and preservative concentration required to completely inhibit the growth of *Pseudomonas aeruginosa* and *Aspergillus niger*. The complexing tendency of sorbic acid for Tween 80 was found to be less than that of the parabens hence there should be less interference with the activity of sorbic acid in formulations containing Tween 80 or similar surfactants than in formulations preserved with the parabens. A correlation was shown to exist between the predicted and experimentally determined effect of Tween 80 on the inhibitory concentration of sorbic acid in vitro.

Microfilm \$2.50; Xerox \$4.40. 81 pages.

##### THE EFFECTS OF SPRAY DRYING ON SOME PHARMACEUTICAL GUMS

(L. C. Card No. Mic 60-5134)

Richard Allen Hill, Ph.D.  
The University of Florida, 1960

Four water-soluble gums of pharmaceutical importance - acacia, tragacanth, karaya and sodium alginate - were selected for preparation in spray-dried form. The resulting modification in particle size and shape was expected to produce a gum particle with the high dispersion rate characteristic of spray-dried products. This increase in rate would be an advantage in prescription compounding and manufacturing procedures provided it was obtained without adversely affecting other valuable gum properties. The investigation undertaken involved two phases: first, the preparation of the gums in a spray-dried form; and second, a comparison of the product with control samples.

Spray drying of all gums was accomplished in a Bowen Pilot Plant Spray Dryer operated at drying temperatures varying from 150 to 260° C. Homogeneous, aqueous gum dispersions of suitable concentrations were gravity fed to a centrifugal sprayer which atomized the material into a stream of hot flue gases. The dry product was removed



by a cyclone collector, sifted, and stored for future study.

Experimental gum materials were obtained from the spray dryer with varying degrees of success. Because of high solids concentration and relatively low viscosities, solutions of acacia were readily dried. However, it was found necessary to pre-heat the dispersions of tragacanth, sodium alginate and karaya to reduce the viscosity while maintaining a reasonable solids content. High operating temperatures and low production rates were encountered, but satisfactory products of tragacanth and sodium alginate were prepared. Equilibrium conditions in the karaya-water system would not permit a completely successful application of spray drying techniques.

The spray-dried gums were compared to control samples on the basis of physical characteristics of the dry gum powders, physical properties of aqueous gum dispersions, and chemical and spectral analysis of the dry gum powders. The spray-dried materials generally had a lower bulk density, a shorter dispersion time, a lower moisture content, and equivalent equilibrium moisture content. Average particle size was less than 100 mesh and a hollow, spherical shape predominated. The pH of aqueous dispersions was unchanged except for a slight increase observed in dispersions of sodium alginate. Measurements of viscosity as a function of concentration and of time indicated that acacia was spray dried without adverse effects. All other spray-dried gums suffered losses in viscosity varying from 25 to 50 per cent of the control, and these differences increased with time. Chemical and spectral analysis of acacia and karaya did not show appreciable differences between spray-dried and control samples. The same methods indicated that tragacanth had undergone hydrolysis and that decarboxylation of the sodium alginate molecule had occurred during the experimental process.

Establishment of a cause and effect relationship for the behavioral changes observed was complicated by the presence of several process variables. The gums in this study were subjected successively to solvent action, shear stresses, heat while in solution, and finally, dry heat. Each of these individual conditions has been shown previously to have an effect upon gum characteristics. Any observed change in chemical or physical property was therefore produced by the integral action of these factors.

The results of this investigation indicated that the particular experimental process used for spray drying would yield a product having different characteristics than the control samples. However, the advantages of a spray-dried product, principally a lower dispersion time and a more uniform particle size and shape, were obtainable only by sacrificing other pharmaceutically important properties, particularly the ability to impart high viscosities to aqueous dispersions.

Microfilm \$2.50; Xerox \$6.40. 131 pages.

## HEALTH SCIENCES, PUBLIC HEALTH

### THE PUBLIC HEALTH EDUCATOR RECRUIT: AN ANALYSIS OF THE TYPES OF BACKGROUND IN RELATION TO ACADEMIC SUCCESS, A SEARCH FOR CRITERIA FOR SELECTION FOR THE PROFESSIONAL SCHOOL.

(L. C. Card No. Mic 60-4849)

Akbar Moarefi, Ph.D.

The University of North Carolina, 1960

Supervisor: Rosemary M. Kent

#### 1. Introduction

The least common denominator for admission to a school of public health for receiving a graduate degree with a major in public health education is a bachelor's degree with adequate preparation in natural and social sciences. Applicants for M.P.H. degree should, in addition, have at least one year of graduate study in public health or should have experience of not normally less than three years in public health or in teaching.

Beyond the minimum admission requirements, there exists a tremendous disparity in backgrounds of the recruits as to their age, type and extent of formal education, and experience.

#### 2. Statement of the Problem

The relative newness of public health education as a profession and the ever-increasing demand for professionally prepared public health educators have pointed to the need for exploration of relationships between the background of the recruit and his eventual success in professional contribution.

A first step in this exploration is the investigation of the relationships between background factors and academic success in schools of public health. An adequate knowledge of public health (reflected through academic success) is imperative to a successful professional contribution. The study herein abstracted was, therefore, designed to explore the relationship between the background of students and their academic success.

#### 3. Procedure

Academic success in the study of public health was measured by quality-point averages of grades in (1) public health education courses, (2) basic public health courses, and (3) weighted average of the two.

Considered in the study were only students from within the Continental United States who had enrolled to study toward a graduate major in public health education in one particular school--the School of Public Health, University of North Carolina--between and including the academic years 1942-1943 through 1957-1958. This demarcation provided a relatively comparable set of backgrounds and reasonably uniform course content and grading system. No other limitations were made, and no sampling within the school was involved. Analysis of records of 292 students (101 men and 191 women) provided a base for the study. This group constituted approximately one-third of all American public health educators professionally prepared within the time period.

Of this group, 105 (44 men and 61 women) had completed

a battery of tests administered by the University's Testing Service. Scores on two tests--the Ohio State University Psychological Test and the Kuder Preference Record--provided additional sources of information for this subgroup.

Fifty-eight factors--age; sex; undergraduate major, minor, academic average, and type of institution; graduate study and degree; type and duration of experience; lapse in formal education; and scores on Ohio and Kuder tests--were included in the study. These factors were coded on IBM cards for testing against each of the three criteria of academic success. The data were programmed as a multiple regression problem and were processed by the electronic computer (Univac 1105).

#### 4. Results

Major findings were as follows:

- a) Younger and older students in the range of 20-55 years met academic success less frequently than did the middle age groups.
- b) Undergraduate quality-point average was found to be the most reliable single predictor of academic success in the professional school.
- c) Undergraduate majors in education showed considerable success in one criterion--public health education courses.
- d) No other undergraduate major involving a sizable number of representatives demonstrated any significance. Obviously, the study tested only the excess above minimum admission requirements.
- e) Graduate study prior to enrollment presented close association with academic success in basic public health courses.
- f) The Ohio State University Psychological Test was significantly related to academic success for both men and women. The clerical scale of the Kuder Preference Record showed negative association with academic success for women.
- g) Only one type of experience--work in biological or bacteriological laboratories, chiefly college laboratories--showed significant association with academic success. Experience in teaching or in public health--a partial requirement for admission to the school--demonstrated no significant association with academic success.

The forty-eight factors dealing with background accounted for close to one-third of variability in academic success. The same proportion held true for the Ohio and Kuder tests for women. For men, the proportion of the latter was considerably lower.

The dissertation includes a fifty-two page introduction which traces the history of professional preparation of public health educators.

Microfilm \$2.55; Xerox \$9.00. 196 pages.

#### PERSONAL ADJUSTMENT IN AGING IN RELATION TO COMMUNITY ENVIRONMENT. A STUDY OF PERSONS SIXTY YEARS AND OVER IN CARRBORO AND CHAPEL HILL, NORTH CAROLINA.

(L. C. Card No. Mic 60-4871)

Edith Virginia Stone, Ph.D.  
The University of North Carolina, 1960

Supervisor: Lucy S. Morgan

The study is an exploration of factors within community environment which influence personal adjustment in aging. The principal point of examination was the way in which social institutions, as part of the community environment, affect adjustment in aging. The institutions studied were the family, religion, economics, and education. Three divergent communities were selected for comparative study. These included a mill community, a Negro community, and a university community located adjacent to each other and in the South.

A census of persons sixty years and over, or those born previous to January 1, 1899, was conducted to provide a broad view of the population characteristics of the older age group. From the 910 individuals located through the census, a sample of 100 was selected for intensive study. As previous studies had indicated differences in personal adjustment by sex and marital status, the sample, which was drawn at random, was stratified for these two factors.

Semi-structured interviews were conducted to determine personal adjustment ratings and to collect data relating to social institutional structure and functions during the lifetime of each individual. A content analysis of these data and a review of historical literature provided the data for analyzing community environment in relation to social institutional structure and functions. Personal adjustment ratings were obtained by the use of previously tested schedules concerned with activities, attitudes, and morale of older people. Statistical analysis was performed to determine the relationship of personal adjustment and social institutional structure influences in aging.

It was concluded that family institutional patterns varied in the three communities, and built within these variances were differences in family expectations and role performance. The economic structure had a strong interrelationship to all other institutions. It had influence in determining the style of life of the community. Difference in this structure by communities affected the length of work life, health, education, leisure time, and patterns of retirement. Closely allied with the economic institution of the day was that of the institution of education. This proved to be an outstanding example of the relationship of educational attainment and the structure of the institution within a given community. Level of education attained was influenced by the opportunity for education. The higher the level of education, the better the adjustment to aging. Those who had an opportunity to develop creative ability through education seem to be those who made the best adjustment to aging. Those activities and attitudes least affected by education were those concerning the family and religion.

The institution of greatest influence appeared to be that of religion. The structure of this institution varied by communities and, because of its structure, varied in functions



within the individual community. In all three communities, there was some evidence of increased interest in religion with aging.

Though other studies have advanced marital status and sex as major factors influencing adjustment in aging, these were not found as major influences in these communities.

There were manifestations to indicate that personal adjustment varies by race and that this variation could be due to the differences that were found in the social institutions.

The findings seem to support the major hypothesis that personal adjustment in aging is influenced by community environment and that it is through the social institutions that community environment is created or vice versa. It would appear that adjustment in aging is partly the result of the structure of social institutions within a community. The institutions of influence varied by communities. Microfilm \$3.75; Xerox \$13.05. 289 pages.

STUDIES ON THE IMMUNITY RELATIONSHIPS  
IN WHITE MICE GIVEN INFECTIONS  
WITH *NEMATOSPIROIDES DUBIUS* BAYLIS,  
1926 (NEMATODA: HELIGMOSOMIDAE).

(L. C. Card No. Mic 60-4875)

Paul Doyle Van Zandt, Ph.D.  
The University of North Carolina, 1960

Supervisor: John E. Larsh, Jr.

Three series of experiments, involving 702 mice, were performed with the nematode, *Nematospiroides dubius*, to determine certain immunity relationships.

Series One consisted of five experiments. The first experiment demonstrated that, under the experimental conditions, no immunity was demonstrable in mice challenged after being given one stimulating infection with 50 *N. dubius* larvae. In the second experiment, a definite, if not statistically significant, trend was noted in that fewer adult worms were recovered from those given two stimulating infections before being challenged. In the third experiment, a significant reduction in the number of adult worms was noted in the mice that had received three stimulating infections, indicating the development of a strong acquired immunity. These results, the first showing immunity against *N. dubius*, suggest a quantitative basis for the immunity as demonstrated in other host-parasite combinations.

In the fourth experiment, the adult worms from all three stimulating infections were permitted to persist until four days prior to the challenging infection, rather than removing those present 21 days after each stimulating infection as in the previous experiments. Despite this increased persistency of the adults, allowing opportunity for much greater antigenic stimulation, the degree of the immunity demonstrated was similar to that noted in Experiment III. This suggested that the adults played a minor role in the immunity demonstrated, and encouraged the experiments of Series Two to test this hypothesis.

In the fifth experiment, there was no significant difference in the number of adult worms recovered from immunized mice between 15-60 days after the challenging

infection. Thus, the worms noted encysted in the intestinal tissue at 15 days did not succeed in reaching the lumen within an additional 45 days, suggesting they were trapped by the defensive mechanism(s).

Series Two consisted of seven experiments. The first six experiments established: (1) the time periods after one, two, and three separate infections when the adult worms (phase II) appeared in the lumen of the small intestine, and (2) that almost all of the adult worms (phase II) from one, two, and three separate infections were removed within a brief period of time by giving two  $\text{CCl}_4$  treatments. In the final experiment of this series, by using the time periods determined in the first six experiments, a striking degree of immunity was demonstrated in mice given three stimulating infections and treated with  $\text{CCl}_4$  to remove almost all of the adults (phase II) soon after their emergence into the lumen of the small intestine. This provided strong evidence, if not conclusive proof, that the adults did not play a demonstrable role in this immunity. Thus, the tissue-invading larvae (phase I) must account for the major part, if not all, of the immunity.

In the single experiment of Series Three an artificially acquired immunity was produced by injections of an antigen made from the larvae (phase I) of *N. dubius*. It is clear, therefore, that this phase contains a functional antigen(s), which encourages further studies to determine precisely the role of the larvae in this immunity.

Microfilm \$2.50; Xerox \$5.00. 100 pages.

HEALTH SCIENCES, SURGERY

GELATIN SEALING OF  
FABRIC ARTERIAL GRAFTS

(L. C. Card No. Mic 60-3547)

John Upton Bascom, M.D., Ph.D.  
University of Minnesota, 1960

Adviser: Claude R. Hitchcock, M.D.

Gelatin has proved successful as a temporary sealing agent for fabric arterial grafts. It prevents acute blood loss yet it is absorbed quickly enough in the animal body to permit a rapid penetration of fibroblasts into the pores of the fabric during the healing process. Knit Teflon and Dacron grafts were saturated with warm 7% gelatin solution. Excess solution was drained off while still warm. As the coating cooled, the solution formed a gel, stabilizing the thickness and distribution of the gelatin seal. The dipped grafts were then dried carefully and completely at room temperature. It was necessary to hold grafts under slight tension during drying to separate adjacent crimps enough to prevent their being glued together. Dried grafts were then baked in an oven for four hours at 285°F. The high temperature denatured or polymerized the gelatin to render it less soluble and more slowly digestible by the tissues. Gelatin coated grafts were inserted into the carotid arteries and the abdominal aortas of 80 dogs. Each graft was compared with its own untreated control graft

inserted into the same animal in a symmetrical site on the same day.

Gelatin coating sharply limited blood loss from the fabric pores. Knitted control grafts had a consistent heavy blood loss. Of 80 animals treated, 40 had no blood loss whatever from the gelatin dipped grafts. Treated grafts and their untreated controls were carefully compared for any evidence of adverse reaction to gelatin. Gelatin coating did not lead to thromboses, infection, nor hematoma formation. Treated and untreated Teflon grafts induced minimal and identical tissue reaction.

Gelatin foam sponges are currently in use as hemostatic agents. This fact might make one fearful of the effect of gelatin when used on arterial grafts. Far from encouraging clotting, gelatin coating seemed to delay thrombus formation in a few applicable instances in vivo. For in vitro testing of the thrombogenic properties of gelatin, glass test tubes were coated with various materials after which the tubes were used to perform Lee-White clotting times. Average clotting times in minutes were as follows: Glass 10.5, paraffine 11.5, gelatin 14.8, silicone coating 16.5. Thus it seemed that gelatin coatings actually delayed clotting.

Total healing time for grafts was prolonged by approximately 10% in the treated grafts. Gross and microscopic patterns of healing were otherwise identical. Conclusions in this thesis are based upon follow-ups of one day to six months with an average follow-up of about six weeks. Though brief, this period is considered adequate since all failures occurred within one month of insertion and all gelatin, which might affect healing patterns, was completely absorbed by the twentieth postoperative day. In fully healed pairs removed four to six months postoperatively, treated and control fabrics could not be distinguished.

A study was made of the reasons that some of the grafts failed to heal. Hematomas, serum accumulations, and gross infection obviously stopped healing. Evidence suggested that subclinical infections of the fibrin lining of the inside of the grafts might be a factor in delayed healing. Such minimal infection was evident on microscopic examination only. A unicellular "endothelial" layer invading prematurely over fibrin not yet replaced by fibroblasts, seemed to delay healing. The fact that the walls of occluded grafts were rapidly penetrated by fibrous tissue, as compared to slow penetration of the walls of patent grafts, suggests that arterial blood flow itself may also delay healing.

In clinical use, gelatin coating provides a method for taking advantage of the benefits of porous knitted grafts without hazards of excessive blood loss.

Microfilm \$2.75; Xerox \$9.45. 209 pages.

#### THE EFFECT OF HYPOTHERMIA ON EXPERIMENTALLY INDUCED PANCREATITIS

(L. C. Card No. Mic 60-5180)

Conrad Belnap Jenson, M.D., Ph.D.  
University of Minnesota, 1960

The studies of Wangenstein and coworkers demonstrating the protective action of hypothermia against ex-

perimentally produced peptic esophagitis in cats suggested that local or general body cooling might be of value in the treatment of other diseases in which enzymatic processes have been indicted as etiological factors, such as pancreatitis. This thesis assesses the effect of hypothermia on pancreatic secretion, esophageal lesions following in vivo perfusion of the cat esophagus with solutions of bile salts, and acute pancreatic necrosis produced by pancreatic ductal injections of bile salts, trypsin, gastroduodenal contents, and by the local Shwartzman reaction.

The effect of general body cooling to 25-30°C. was evaluated in pancreatic necrosis attending ductal injection of bile salts in rats, and the local Shwartzman reaction in rabbits. The influence of local pancreatic hypothermia to 10-25°C. was assessed in pancreatitis induced in rabbits by ductal injection of duodenal juice, and in dogs by solutions of ox bile salts, trypsin, pepsin, hydrochloric acid, and human gastric juice.

Although pancreatic secretion was markedly reduced by cooling, pancreatitis was easily induced in animals subjected to decreased temperatures. The mortality and morbidity was greater in animals subjected to local pancreatic or general body hypothermia, than in the control groups. Gross and microscopic examination of the pancreas showed no significant differences in the lesions produced at normal or decreased temperatures. The striking finding following in vivo esophageal perfusion with bile salt solutions was the presence of bile stained fluid in the mediastinum and pleural cavities without obvious ulceration or perforation of the esophagus. This abnormal permeability was not significantly altered by hypothermia.

Analysis of the methods and results of these experiments suggests the toxic action of bile, acid, and bacterial factors are of great importance in the experimental production of pancreatitis, which are not favorably influenced by cold. Furthermore, it would appear that any decrease in toxic enzymatic processes in pancreatic necrosis due to lowered temperature may be negated by injurious effects of cold, such as decreased phagocytosis, temporary loss of the circulating plasma volume, and ischemia produced by vascular stagnation and cessation of capillary blood flow. These findings suggest that the lethal processes in pancreatic necrosis are not simple enzymatic reactions that can be favorably altered by hypothermia.

Microfilm \$2.50; Xerox \$4.00. 75 pages.

#### OBSERVATIONS ON SOME FACTORS INFLUENCING BLOOD FLOW IN THE LUNGS

(L. C. Card No. Mic 60-5181)

Albert Mowlem, M.D., Ph.D.  
University of Minnesota, 1960

Adviser: Richard L. Varco, M.D.

It has long been of interest from clinical and physiologic standpoints to determine the effect of changes in body position on the blood flow and ventilation of each lung. From bronchspirometric studies showing increase in oxygen consumption by the dependent lung, previous workers have concluded this lung receives more blood.



The present investigations were undertaken to determine more accurately the changes taking place in the pulmonary circulation when the position of a lung is changed.

In order to accomplish this, the ventilation of each lung was separated by a specially designed double-lumen endotracheal tube. In addition cannulation of the pulmonary artery and vein of each lung was also carried out to permit the withdrawal of blood samples and the measurement of pressures in the anesthetized and naturally breathing dog. Therefore, actual blood flow measurements through each lung was obtained by the Fick technique while simultaneously recording the pressures in the corresponding pulmonary artery and vein, enabling calculation of the vascular resistance in each lung.

Under the conditions of the experiments in this study, the pulmonary vascular resistance in an individual lung decreased with simultaneous increase in the flow of blood whenever the lung was placed in a dependent position. The mechanism for these changes appeared to be a rise in the pulmonary vein pressure (outflow pressure), perhaps due to gravity, with the result that the pressure gradient across the vascular bed was reduced resulting in a fall in resistance and an increase in the flow of blood.

In addition to the above study, it was possible to study the effects of hypoxic breathing and also of denervation of one lung on the pulmonary circulation, using the same experimental preparations as in the position change experiments. This was accomplished by using one lung as a control while the other one was made hypoxic by breathing pure nitrogen with and without denervation of the same lung. The dogs were subjected to unilateral hypoxia for twenty minutes and the studies suggested that the pulmonary vascular resistance decreased in response to low alveolar oxygen tension and resulted in increase in the fraction of the cardiac output perfusing the anoxic left lung. The cardiac output also increased, perhaps due to severe anoxemia. The importance of measuring the pulmonary vein pressure was brought out in this study, for, although the pressure in the pulmonary artery increased, this in fact resulted in a decrease rather than an increase in the resistance. A simultaneous contraction of the pulmonary veins caused elevation in the intraluminal pressures of these vessels and so reduced or prevented the increase in the pressure gradient across the lung. As in the experiments on the effects of position change, elevation of the pulmonary vein pressure resulted in a fall in vascular resistance. The pulmonary vascular bed, like those elsewhere in the body, apparently reacts to anoxia by dilatation and it is not necessary to postulate, as others have done, that it contracts, simply from the observation of increase in the pulmonary artery pressure. The measurement of the pulmonary vein pressure (or outflow pressure) is thus of vital importance in arriving at conclusions relative to the dynamic changes taking place in the vessels of the lungs.

When the autonomic innervation of one lung was interrupted, as was done in this study, there did not appear to be any change in the response of the pulmonary vascular bed to unilateral hypoxic breathing. This suggests that the tone of the pulmonary vasculature may be modified by factors which bring about local reflexes irrespective of whether central nervous system connections are present.

Microfilm \$2.50; Xerox \$5.80. 120 pages.

## THE UPTAKE OF RADIOACTIVE PHOSPHORUS BY HUMAN AND EXPERIMENTAL TUMORS

(L. C. Card No. Mic 60-5617)

Donald Berrard Shahon, M.D., Ph.D.  
University of Minnesota, 1960

Adviser: Owen H. Wangensteen, M.D.

In vivo surface activity measurements, obtained four hours to six days after  $P^{32}$  administration, over tumor-bearing ears in rats were significantly greater than that noted over inflammatory and normal ears in the same animals.

Similarly, in vitro surface activity measurements of human gastrointestinal specimens containing malignant neoplasms demonstrated a significant increase over the cancer as compared to the normal adjacent area of that same organ in 65 to 68 cancers studied. Ten of the eighteen benign gastrointestinal lesions exhibited increased surface activity measurements similar to that noted over the cancers. These included some benign gastric ulcers and colonic polyps.

Radioactive phosphorus has been shown to be incorporated into rapidly growing tissues to a greater extent than in normal tissues, whether this be tumor or regenerating tissue, and thus explains the increase over the cancers. The increased surface activity measurements over the benign lesions may be due to epithelialization of the ulcer or perhaps these lesions were premalignant and the increase in  $P^{32}$  uptake was due to functional changes of malignancy occurring before the morphologic changes.

Specific activity determinations of total phosphorus, DNA-phosphorus, and acid-soluble phosphorus in transplanted mammary adenocarcinomas and normal stomachs of ZBC mice following  $P^{32}$  administration demonstrated a marked increase in all these fractions as compared to those of the normal stomachs. Determinations were made at 4, 24, 48, 96, and 192 hours after  $P^{32}$  administration. Similarly, specific activity measurements and distribution absorption ratios of total phosphorus of human alimentary tract tumors were greater than that noted for the adjacent normal mucosae of the same organs. This increase was not as consistent as that noted in the experimental animals.

In vivo surface activity measurements of gastrointestinal organs suspected of harboring a malignancy in human patients were obtained by the passage of a microprecision Geiger-Muller tube either through the oral cavity of rectum following the administration  $P^{32}$ . Measurements were consistently higher over the cancer as compared to the normal organ. Except for one case, none of the gastric ulcers counted in the cancer range.

Radioautographic studies of resected human gastrointestinal organs following  $P^{32}$  administration confirmed the greater uptake by the cancers as compared to the normal organs. In addition, benign gastric ulcers demonstrated a lower uptake than did the normal organ.

Microfilm \$2.50; Xerox \$7.00. 149 pages.

## HISTORY

### HISTORY, GENERAL

#### SOUTHERN ATTITUDES TOWARD NEGRO VOTING DURING THE BOURBON PERIOD, 1877-1890.

(L. C. Card No. Mic 60-5185)

Donald Norton Brown, Ph.D.  
The University of Oklahoma, 1960

Major Professor: John S. Ezell

At the conclusion of the Civil War a primary problem to be solved involved the political position to be occupied by the freedmen. Most Southern whites opposed the immediate enfranchisement of the Negroes, but their opinion was ignored by the Radical Republicans who were determined to use the colored vote to increase the power of their party. By employing the Negro vote the Republicans were able to dominate, for varying lengths of time, the governments of the former Confederate states. Republican utilization of this vote, coupled with the corruption with which their administrations were charged, resulted in the solidification of the whites in support of the Democratic party. The white supremacists, led by individuals later termed Bourbons, employed legal and extra-legal methods to resist the Republican-Negro combination. By 1877 their efforts to achieve home rule had succeeded throughout the South.

Achievement of home rule did not result in immediate disfranchisement of the Negro. Although most Southern states adopted measures which could be used to limit colored voting in the years before 1890, these were not always implemented and in every state Negroes continued to vote and to seek office. In national elections they usually voted for Republicans, but in state contests their support, because of "fusion" agreements, was often available to the Bourbons. This fact enabled the business-oriented Bourbons to maintain political control despite opposition to their policies from the rural element.

Continued Negro voting resulted in the development of three general attitudes. A minority of whites composed the groups of liberals who denied the contention of the radical majority that Southern welfare demanded the complete disfranchisement of the Negro. The liberals insisted the ballot had a civilizing influence and constituted a right which could not legally be denied. Most Bourbons, desirous of placating the North and of using the Negro vote to retain political control, adopted a posture of moderation. They denied the liberal contention that the franchise constituted a right, but insisted the South would not deprive the Negro race of the voting privilege.

Antagonism of the rural element toward Bourbon economic and racial policies increased during the decade of the eighties. By 1890 Bourbon leaders were seeking to lessen the threat posed to their domination by the Farmer's Alliance by becoming more radical toward the colored vote. This reversal in attitude, however, did not prevent the defeat of the Bourbons and the accession to power of the

class traditionally antagonistic to the Negro. When that occurred the days of the Negro as an important factor in Southern elections were numbered.

Microfilm \$3.70; Xerox \$13.05. 287 pages.

#### HENRY ADAMS AND BROOKS ADAMS: THE SEARCH FOR A LAW.

(L. C. Card No. Mic 60-5186)

Timothy Paul Donovan, Ph.D.  
The University of Oklahoma, 1960

Major Professor: John S. Ezell

Henry Adams and his brother, Brooks Adams, have a unique and important position in American historiography because each attempted to formulate laws for history which would be as valid as the laws of the physical and natural sciences. While the laws they suggested did not prove universally applicable, the significance of the Adamsses is found in the attempts they made.

The forces of change which transformed America after the Civil War had their impact on the writing of history. Industrialism, urbanization, technological advance, and theoretical science helped to form the new social and cultural milieu in which Henry and Brooks Adams lived. Each responded to the new civilization differently; each sought a way to explain the increasing complexity of American life. Those forces which had the greatest influence on Henry Adams' search for a law were religion, Darwinism, and relativism while the facts most affecting Brooks Adams were religion without supernaturalism, economic determinism, and an unlimited Darwinism. Both rejected traditional Christianity although the admiration for the faith of the Middle Ages was strong in Henry Adams. Brooks Adams accepted more completely evolutionary tenets, and each of the brothers placed heavy stress upon new "scientific" doctrines.

The laws which Henry and Brooks Adams thought they had discovered were essentially pessimistic. Basing his findings on physics, Henry saw ultimate degradation or dissipation of all energy as the world's eventual fate. Brooks who looked to economics and biology viewed history as repetitive cycles of imagination and concentration finally leading to civilization and decay. Both theories contained defects, the most serious of which was the uncritical transference of the postulates of the sciences to dissimilar areas. There was also the tendency for the Adamsses to assume certain propositions as axiomatic before such concepts had been satisfactorily proven. The law of degradation was more pessimistic than the law of civilization and decay in that it assumed that a state of complete degeneration was close at hand. Hence, Henry Adams had less concern for the state of contemporary society than did his brother.

1923

*The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm.  
Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.*



The search for an historical law was closely related to the "American dream" tradition, and the Adamses carefully scrutinized the history and society of the United States to determine if there was any justification for hope in the realization of the American dream of a more perfect democracy. Henry Adams found no basis for such a faith; Brooks Adams believed in a new and less idealistic dream.

The principal influence which the Adamses have exercised on American historiography was to force a clarification of the term, "scientific history" and to challenge historians to apply their findings to all history instead of remaining aloof in the narrowness of specialization.

Microfilm \$3.10; Xerox \$10.80. 240 pages.

THE AMERICAN LOYALISTS  
AND THE PLANTATION PERIOD  
IN THE BAHAMA ISLANDS

(L. C. Card No. Mic 60-5143)

Thelma Peterson Peters, Ph.D.  
The University of Florida, 1960

At the close of the American Revolutionary War several thousand American loyalists moved to the Bahama Islands, 1,458 from New York, and most of the others from East Florida. This dissertation is a study of those Loyalists: who they were, how they got to the Bahamas, how they lived after they got there, and the extent of their influence on their new environment.

There is no standard history of the Bahama Islands. The sources for this dissertation were the newspapers of the time, the record books in the Registry Office in Nassau, the Legislative Acts in the files of the House of Assembly in Nassau, personal interviews with Bahamians who were descendants of the Loyalists, a diary of a Loyalist planter, the accounts of two famous travelers to the Bahamas, Johann David Schoepf in 1783 and Daniel McKinnon in 1803, and various letters and other documents.

The Bahamas, an archipelago of some seven hundred scattered and rocky islands, had been settled in 1647 by English Puritans from Bermuda. These old inhabitants, called Conchs by the Loyalists, were a dour, hardy, unlettered people who lived largely from the sea--as wreckers, beachcombers, fishermen, turtlers, and salt rakers. In 1783, the Conchs numbered about four thousand.

The Loyalists represented diverse interests but one pattern showed a predominance--that of a well-educated, slave-owning merchant-planter who had moved to America from Scotland or England, usually after 1735, and who had settled in South Carolina or Georgia. These Loyalists had sought new homes in East Florida during the war only to find themselves dispossessed once more at war's end when Great Britain handed the Floridas over to Spain.

The southern Loyalists of this "aristocratic" slave-owning class were particularly unwelcome to the Conchs who resented their airs of superiority. The old inhabitants were somewhat more tolerant of the Loyalists who came from New York for they were mostly former soldiers, humbler and poorer people who owned no slaves and were not able to establish plantations. These northern Loyalists were forced to adopt the Conch way of life, life from the

sea, and as a result they were soon intermarrying with Conchs.

A political clash between Loyalists and Conchs was inevitable. Not until 1797 were the Loyalists completely victorious. During the conflict both factions were guilty of bad spirit and recrimination. The Loyalists forced the recall of two royal governors, John Maxwell and John Earl of Dunmore.

The slave-owning Loyalists established cotton plantations on New Providence Island and on hitherto uninhabited islands to the south. All received grants of land from the British Government as a partial compensation for their American losses. Interest in sea-island cotton amounted almost to a mania. About 250 plantations were established, modeled after similar plantations in South Carolina and Georgia. For a number of reasons, the plantations failed: soil exhaustion, insects, drouths and blistering winds, and lack of agricultural skill. Already in decline in the early 1800's, the plantation system came to an end when Great Britain freed the slaves in 1834. The white planters used their slave compensation money to move to Nassau and start new ventures or to leave the colony entirely. After 1834, the plantation islands were inhabited almost exclusively by the former slaves and by the numerous mulatto offspring of the white planters.

Today the plantations are gone, destroyed by fire or hurricane, their rubble covered by a century of jungle growth. While many descendants of the Loyalists live in the Bahamas they have little tradition of or interest in this chapter in their past.

Microfilm \$2.65; Xerox \$9.25. 203 pages.

THE DEPARTMENT OF WAR,  
1781-95.

(L. C. Card No. Mic 60-5118)

Harry Merrill Ward, Ph.D.  
Columbia University, 1960

This is a study in the administration of the Department of War from its establishment in 1781 until the appointment of a successor to Secretary Knox in January, 1795. The study of this executive department reflects the course of central government during the Confederation and the transition into the Federal Government. The Department of War was a vital link between the Confederation and the new government. The treatment in this study is chronological.

The creation of the War Department and the administration of the first Secretary of War is discussed in the beginning chapters. General Lincoln performed the valuable service of a liaison between Congress and the army. The War Department was primarily a central record-keeping agency which evaluated returns from the various army units. The war office was also a channel for processing military correspondence relating to such matters as pensions, pay, commissions, and patronage. In several areas the role of General Lincoln as Secretary of War was of primary importance: particularly, in the shaping of policy through recommendations to Congress and the Commander-in-Chief, and in direct control over ordnance.

During the interim between the terms of Lincoln and

Knox, the Secretary in the War Office, Joseph Carleton, assumed the responsibilities of the office, which, with the government in a stalemate during 1784-5, hardly amounted to more than administrative routine. For the remainder of the Confederation, the War Department under General Knox assumed command and logistical functions of the small peacetime army. Indian affairs became an important province of the war administration. Indian affairs were of a dual aspect: the Indians of the Western Territory and the Southern Indians, particularly the Creeks and the Cherokees. The Secretary of War carried on negotiations with the Indians and supervised the policing of the frontiers by the small federal army. Secretary Knox was largely responsible in formulating federal Indian policy, which was often at odds with the states.

Attention is given to the political and administrative views of Secretary Knox during the period of drawing up the Constitution and the establishing of the new government. The influence of Knox during the first year of Washington's administration is stressed--which influence is gradually relinquished to Hamilton. There is a chapter on the emergence of the Cabinet.

The War Department sheds light on federal-state relations, particularly in Indian affairs and in such crises as the Shays's Rebellion, the Genet Affair, and the Whiskey Insurrection. Recruitment for the federal army and the raising of militia presented constant problems for the Secretary of War to work out with the local authorities.

The Indian campaigns in the west were a primary concern of the Secretary of War during 1790-5. The role of the War Department in the Harmar, St. Clair, and Wayne campaigns is discussed. Significant military lessons were learned. In 1794, the efficient employment of a legionary force under General Wayne in the West and a militia army in Pennsylvania vindicated the establishment of a national war executive administered through the Department of War.

Microfilm \$7.15; Xerox \$25.45. 564 pages.

## HISTORY, MODERN

### TEXAS: 1860-1866. THE LONE STAR STATE IN THE CIVIL WAR.

(L. C. Card No. Mic 60-5822)

Allan Coleman Ashcraft, Ph.D.  
Columbia University, 1960

Texas, in 1860, was a half-settled state that was being shaped by both Southern and Western influences. Texans had to improve their Indian defenses, devise a more effective transportation system, and develop large-scale marketing facilities for their great cattle herds. On the national scene, Texas was faced with the slavery controversy and the crucial issue of secession. When the Southern states withdrew from the Union, strong ties between Texas and her neighbors to the east caused her to follow their course of action. Although the state's Ordinance of Secession was ratified by a majority of the voters, the Secession Convention and its subordinate committees

managed to get Texas very deeply immersed in disunionist schemes well before the people had approved such a step.

With the coming of the war, many of the difficulties that Texas had faced in the past were made more complex as the state attempted to support the military efforts of the Confederacy. Almost 20% of the white population was taken into military service. The bulk of these soldiers took Texas weapons with them as they marched out of the state to aid Southern defensive efforts elsewhere. Financially, the state had to face its share of the war expenses, support defensive forces on the frontier, set up machinery for the production of the tools of war, and provide relief for indigent families of soldiers. The state also passed appropriations to provide medical services and facilities for recuperation for wounded Texans in the Confederate armies.

On the home front, the state government had to contend with the demands and decrees of high-handed Confederate officers, gear the state to the demands of war, develop overland trade with Mexico (especially important to the South as it constituted the only open outlet for commerce once the Union blockade was instituted), provide basic items that were necessary for the survival of its people, and crush disloyalty to the Confederate cause.

When the Union took Vicksburg and gained control of the Mississippi River, the Southwest was isolated from the Confederacy and was forced to rely on its own leadership, initiative, and resources for the remaining twenty-two months of the conflict. General Edmund Kirby Smith, Confederate commander of the Department of the Trans-Mississippi West, held several conferences with the governors of the states in his command area, and he attempted to place his army in a position to support Confederate military activities elsewhere.

With the surrender of the forces to the east of the Mississippi River, Kirby Smith hoped that his army would continue the resistance. His troops, however, no longer had the will to fight and deserted their commander. Later, when the Southwest surrendered, a number of key leaders of Texas fled to Mexico.

Andrew J. Hamilton became the Provisional Governor of Texas and in that capacity supervised the issuing of amnesty oaths, brought order to the chaotic state, and prepared Texas for the road to reunion.

Microfilm \$4.35; Xerox \$15.30. 339 pages.

### THE COMPANY OF THE HOLY SACRAMENT (1630-1666): SOCIAL ASPECTS OF THE FRENCH COUNTER REFORMATION.

(L. C. Card No. Mic 60-5085)

Emanuel Stanley Chill, Ph.D.  
Columbia University, 1960

The Company of the Holy Sacrament was a secret organization of laymen and secular priests, dedicated to the extirpation of social disorder and the reimposition of Catholic discipline. It is now generally agreed that this group (sometimes known as the *cabale des dévots*) played a centrally important role in the French Counter Reformation. Previous studies have described its multifarious



projects of charity and social discipline and its extensive, highly centralized network. The present work attempts to relate the Company's development and activities to the social history of seventeenth-century France, in particular to the historic retreat of the aristocracy and the definitive establishment of the absolute monarchy.

The Company of the Holy Sacrament was recruited predominantly from the privileged classes, the old noblesse de race and the newly emerging noblesse de robe. During the seventeenth century these classes were confronted by a severe dilemma of political obedience. Disposed by cultural tradition and corporative interests to resist the extension and consolidation of state power, they were themselves incapable of seizing or controlling that power. From the 1620's to the Fronde, their continuing factionalism was made dangerous by a swelling current of popular unrest. But in creating the conditions for upper-class dissidence, the great popular insurrections of the seventeenth century also set its limits. Economically and culturally remote from the privileged orders, the populace could not form the basis of any enduring political movement against the monarchy; moreover, the violence of the peasants and the urban lower classes threatened not only public order but the position and property of potential upper-class dissidents. During the seventeenth century, therefore, the nobles and magistrates were gradually obliged to relinquish their claims to a significant political role. The monarchy protected the elites' economic privilege and social honor, thus rewarding their increasing docility. Nevertheless, the abandonment of the traditional postures of dissidence involved a lengthy and difficult cultural transformation for the upper classes. The extensive rechristianization of these groups in the second quarter of the seventeenth century suggests one of the ways in which they found it possible to obey tacitly the limits of the new and alien absolutist order.

The history of the Company of the Holy Sacrament is one phase of the complex process whereby the upper classes were domesticated to the absolute monarchy, and its activities show how this process shaped the dominant religious concerns of the age. The hatred of "disorder," so ubiquitous and distinctive in the good works of the French Counter Reformation, was fed not only by a traditional reprobation of popular license and the memory of the political turmoil of the Wars of Religion, but chiefly by the circumambient and interrelated dangers of popular revolt and aristocratic faction. The social projects of the Company of the Holy Sacrament were not motivated by a utilitarian concern for public order, or by positive loyalty to the state, but by a religious renunciation of aristocratic independence which the privileged groups themselves found increasingly insupportable in the real world. The campaigns against blasphemy, prostitution, mendicancy, and the journeymen were mounted by a secret society of ascetics and mystics who regarded their own social activity as an extension of personal asceticism. The Company's vast bureaucratic apparatus was directed primarily against popular license and indiscipline, but inspired by a disgust with the "vanities" of the old aristocratic life, that is, by a hatred of the self.

The Company of the Holy Sacrament epitomized the religious style of the 1630's and '40's--a resolution of ascetic and reforming motifs. However, the triumphs of the state in the 1630's and 1650's weakened the Company's position and with it the whole Counter Reformation. Not

only did Mazarin regard the *dévots* of the Company as ambitious fomenters of "*cabals*": the religious movement was riven by an internal conflict which involved differing attitudes to the state. The emerging Jansenist sect rejected not only the world but also the systematic effort to reconquer it for "order" in the name of religion. On the other hand, the Jesuits and their allies accepted the existing ecclesiastical and social system and supported the aristocratically phrased absolutism which was emerging in the 1650's and '60's. The Company of the Holy Sacrament harbored both tendencies; and although it set itself squarely against overt Jansenism, its own tradition forbade a complete identification with the official Jesuitry of the reign of Louis XIV.

After the religious crisis of the 1650's the *dévots* of the Company represented a kind of expurgated Jansenism: they remained doctrinally and politically obedient and supported elaborate social projects while cleaving to moral rigorism and implicitly condemning the libertine tendencies of the new royal court. However, the efforts of the *dévots* to establish a dead-center orthodoxy between the realistic conformism of the Jesuits and the quietist intransigence of Port Royal made them increasingly unpopular among the new literary audience of *la cour et la ville*--the elite public opinion which supported the absolute monarchy. Thus the government's pursuit and dissolution of the Company in the early 1660's had its ideological counterpart in Molière's castigation of the *dévo*t type in *Tartuffe*. Ostensibly aimed at false devotion, *Tartuffe* was an attack on the average ascetic Christianity of the day and its main target was neither the Jesuits nor the Jansenists, but the Company of the Holy Sacrament, the defender of the old religious style. Launched from the perspective of a youthful royal court, *Tartuffe* linked absolutism with the cause of natural pleasure and condemned the *cabale* not only for meddlesomeness and hypocrisy but for the repressive religion which gave rise to these vices.

Microfilm \$4.90; Xerox \$17.35. 384 pages.

SIMON SNYDER,  
GOVERNOR OF PENNSYLVANIA,  
1808-1817.

(L. C. Card No. Mic 60-5426)

Emerson Lee Derr, Ed.D.  
The Pennsylvania State University, 1960

Simon Snyder was born in Lancaster, Pennsylvania, November 5, 1759, of German parentage. After learning the tanner's trade and attending night school in York County, Snyder went to Northumberland County (now Snyder) in 1784 where he entered the store and mill business with his future brother-in-law Anthony Selin. These business ventures prospered and Snyder invested his profits in local land.

He became, in succession, justice of the peace, judge of the court of common pleas, and delegate to the State constitutional convention of 1789-1790. Here he gave his voice and vote to such democratic principles as a single executive with a qualified veto, bicameral legislature, life tenure for judges, and freedom of the press.

He served as a Democratic-Republican state assemblyman



from 1797 to 1808, with the exception of the session of 1805-1806, when he was an unsuccessful candidate for governor. He served as Speaker of State House of Representatives for four full terms and a portion of a fifth. Snyder was author of the Hundred Dollar Act and the Arbitration Act. The former allowed justices of the peace to hear cases involving sums up to one hundred dollars, while the latter made arbitration a legal procedure in the State of Pennsylvania.

Snyder's good showing as candidate for governor in 1805 encouraged his followers to renominate him in 1808. This time with united Democratic support he defeated his Federalist opponent James Ross by a huge majority. Good political organization and strong support from The Democratic Press and Duane's Aurora aided greatly in the victory.

Snyder followed the Jeffersonian practice of sending written messages to the lawmakers. The Olmstead case occupied much of the time of Governor Snyder and the lawmakers. Snyder, a states' rights man, at first refused to yield to the Federal Supreme Court which had reversed the decision of the State Court of Admiralty. It was also during his first term that he signed the bill to remove the State capital from Lancaster to Harrisburg.

Renominated again in 1811, Snyder was re-elected by an overwhelming majority. Snyder was friendly toward France and favored war with England. He also favored Jefferson's embargo. Snyder loyally supported the war effort in 1812-1814.

In 1814 when the legislature passed a bill for the establishment of forty-one banks, Snyder vetoed the bill. The veto, coming in an election year, threatened his re-nomination, but in spite of his veto he was again nominated and elected to a third term.

Governor Snyder advocated public education and repeatedly urged the legislature to create a system of public schools. While he did not succeed in this effort, his detailed plans bore fruit two decades after his death.

Manufacturing became important while Snyder was Governor, partly because the profits of the mercantile interests were reduced by the precarious state of trade with European countries. The increase in manufacturing and farming led to a demand for more and better roads. In response, the Governor sanctioned the building of many turnpikes in all sections of the State, mostly by private companies, but assisted by the State's purchase of stock.

Having served the constitutional limit as governor, Snyder was elected State Senator from Northumberland County, but served only one session.

He was considered for the vice presidency of the United States as a running mate with James Monroe. Snyder himself discouraged the nomination and did not receive it. John Binns and other Democratic editors tried to launch a campaign to nominate him for governor again in 1820, but these plans were cut short by his death on November 9, 1819.

Snyder's terms as governor were marked by bitter factional fights. The opposition was generally led by William Duane and Michael Leib of Philadelphia. The Snyder faction finally emerged victorious and Simon Snyder became the most powerful political leader in the State during the period of his governorship.

Microfilm \$3.85; Xerox \$13.50. 298 pages.

## THE GERMAN YOUTH MOVEMENT

(L. C. Card No. Mic 60-5823)

Mario Domandi, Ph.D.  
Columbia University, 1960

The birth of the German Youth Movement was an event so modest that its contemporaries took hardly any notice of it. The little hiking club subsequently known as the Wandervogel, founded in 1897 by several secondary school students at the Gymnasium of the middle-class Berlin suburb of Steglitz, seemed nothing more than the banding together of a few adolescents intent upon enjoying the beauty and benefits of the open air and nature. But the appearance was deceptive. Within a decade of its birth, the Wandervogel was an institution of national importance, with branches in all of the larger and many of the smaller German cities.

This dissertation discusses the social, educational, and psychological factors that made possible such rapid growth, as well as the ideas, needs, and circumstances that transformed the Wandervogel from a mere hiking club into a sect representing a new *Weltanschauung* and a new expression of anti-urban, anti-industrial, and even anti-Imperial discontent. In the period before the First World War, the main tasks of the Wandervogel clubs were to consolidate their organization, and to keep clear the lines of demarcation, both organizational and ideological, separating them from adult groups pursuing similar aims. Indeed, the clarification of these aims was itself a major task, for although everyone agreed that the Youth Movement was to seek "the renewal of German life and culture through the spirit of youth," few agreed on what this would entail.

The high point of the Youth Movement's history was the Hohe Meissner Festival in 1913 to celebrate the centennial of the Battle of Leipzig. Many members of Wandervogel clubs, together with youngsters from the youth sections of adult reformist groups, formed a new federation called Free German Youth, which began the second phase of the Youth Movement. The ideal of Free German Youth was "youth autonomy." It would include in its ranks any youth group not directed by adults, and not pursuing religious, political, reformist, or other "adult" aims. Youth was to become conscious of itself as an "estate," i.e., as a natural, constituent of society, with its own specific needs, virtues, and obligations.

This dissertation narrates the vicissitudes of the Youth Movement during the long war, as well as the effects of defeat and revolution. For the movement, the 'twenties were a period of confusion and experimentation. Generally, autonomous youth was indifferent, if not hostile, to the Weimar Republic, preferring instead its own vision of a new and heroic Germany. Further, this dissertation seeks to assess the role played by autonomous youth in the critical period just before the demise of the Republic, especially its support of such splinter groups as the National Bolsheviks, the State Party, the Revolutionary National Socialists, etc. A brief epilogue narrates its part in the resistance movement against National Socialism.

Throughout its history, the Youth Movement embraced neither a systematic philosophy nor a consistent ideology. Rather, it stressed the emotional, sentimental, fundamentally irrational aspects of life, especially in politics, education, and language. The relationship to, and influence of the Youth Movement on each of these fields is discussed in separate chapters.



The Youth Movement is a peculiarly German phenomenon, though the factors that gave rise to it and encouraged its growth were common to all Europe and America. It is also part of a wider phenomenon sometimes called the Conservative Revolution, a world-wide, though predominantly German movement of social and cultural dissidents dissatisfied with the realities of modern industrial society, with the premises and implications of modern scientific thought, and with urban art and urban relationships. They sought to destroy the present and to bring about a new order, to be based on what these men called ancient, vital traditions, which were actually vague memories, visions, and myths of an ideal racial or corporate society, stressing such primitive virtues as physical strength, brotherhood, courage, and instinct. The distinct contribution of the Youth Movement to the Conservative Revolution is also examined in detail in this dissertation.

Microfilm \$5.15; Xerox \$18.25. 401 pages.

**AN URBAN CHURCH IN FERMENT:  
THE EPISCOPAL CHURCH  
IN NEW YORK CITY, 1880-1900.**

(L. C. Card No. Mic 60-5829)

Clyde Griffen, Ph.D.  
Columbia University, 1960

Previously reputed for its social conservatism, the Episcopal Church in New York City in the last quarter of the nineteenth century provided a number of the most prominent spokesmen in America for urban and industrial reform. Protestants who remembered Episcopalian aloofness from the humanitarian crusades of the 1830's and 40's were impressed by the spectacle of a Bishop of New York arbitrating labor disputes in the 1890's and serving as president of CAIL, a church society praised by Samuel Gompers and other labor leaders for its work in promoting trade unionism. Concern with social problems, however, was only one aspect of the church's growing involvement with secular affairs and culture in these years.

This dissertation describes the way in which Episcopalians, members of New York City's largest Protestant denomination, met the social and intellectual problems confronting an urban church in the eighties and nineties. It argues that the debate within the church over Darwinism, biblical criticism, and contemporary theories of political economy greatly increased diversity of opinion within the church.

Since the church provided neither official direction nor effective discipline on matters of belief, clerical reaction to the age's "winds of doctrine" was largely determined by personal interests, temperament, and intellectual training. The dissertation includes intellectual biographies of five prominent clergymen. An examination of the numerous apologetical works written by parish rectors indicates that clergymen did not evade scientific and scholarly challenges to religion. Their apologies, however, were derivative rather than original, usually based on eclectic borrowing from English and European thinkers.

The foreign writers who most influenced Episcopalians did share a belief that Christianity must guide men toward a more just social order. The rhetoric of Christian So-

cialism became so common among clergymen that a few dissenters complained that "individualism" had become a nasty word. In reality, only a small minority sought drastic modification of the competitive system, but a large number advocated trade unionism, municipal socialism, and varying degrees of government regulation of industry and finance.

Serious disagreement and frequent uncertainty about theological matters helped to direct the church's energies to urban missionary and philanthropic work. Whether Anglo-Catholics, Evangelicals, or Broad Churchmen, Single Taxers or economic conservatives, churchmen could agree on the value of parish recreational, educational, and welfare activities, trade schools, settlement houses, and workingmen's clubs. All of these enterprises promoted the traditional and unquestioned middle class virtues of sobriety, industry, thrift, and self-improvement.

Fears prompted by developing class antagonisms and by heavy immigration undeniably stimulated clerical concern with instilling these virtues among the urban poor. And sympathy with the sufferings of the poor came naturally to many clergymen who daily confronted those sufferings within their own parishes. An analysis of the distribution of the laity among social classes reveals that by 1885, lower income families, including Negroes and immigrants, constituted at least one-third of the church's total membership in Manhattan.

Motives of fear and sympathy were abetted by a new and confident spirit in the church, a spirit owing much to contemporary theories of Anglo-Saxon superiority and duty. Episcopalians had their own version of manifest destiny in the eighties and nineties, and it promoted an activism unprecedented in the church's history. Clergymen asserted with increasing confidence that their church would play a leading, and perhaps the dominant, role in the future of American Protestantism, that it was more truly a national church than any other denomination, and, therefore, that it must demonstrate its claims to the allegiance of all Americans by acting in the interests of the entire nation.

Microfilm \$5.70; Xerox \$20.30. 448 pages.

**PENNSYLVANIA'S LITTLE NEW DEAL**

(L. C. Card No. Mic 60-5097)

Richard Calvin Keller, Ph.D.  
Columbia University, 1960

For more than sixty years after the Civil War, Pennsylvania had been dominated by a succession of Republican political bosses in alliance with the business and industrial magnates of the state. During this time the interests of labor, of the consumer, and of various minority groups had been subordinated in one great cause: the protection and expansion of capital. Company police had kept the workers under control, the company town had dominated their nonworking hours, and submissive legislatures had denied their demands for protection.

Then the effects of the progressive movement introduced a new set of circumstances into Pennsylvania politics, and the great depression accelerated the change. In the early 1920's a formidable individual, Gifford Pinchot,



challenged the Republican leaders for control of the party. Energetic, progressive, devoted to the public interest, Pinchot won the governor's chair in both 1922 and 1930. Though his own party thwarted his attempts at reform during the first term of office and the demands of the needy plagued his second, Pinchot and his followers combined forces with urban legislators of both parties after the onslaught of the depression to push through the first items of the program soon to be labeled the Little New Deal. Moreover, his efforts to feed the hungry ranked him high among all state governors.

In 1934 the popularity of President Roosevelt and the New Deal, plus the severity of the depression in the Keystone State, enabled the Democrats to capture the governorship for the first time in over forty years. Members of discontented and economically depressed groups -- labor, the Negro, the nationality blocs -- moved into the Democratic column in large numbers and pulled the party to victory. Governor George H. Earle, III, a newcomer to politics, then set out to bring the New Deal to Pennsylvania. Though balked at first by a Republican-controlled State Senate, the Earle administration won majorities in both legislative branches in 1936 and proceeded to enact the most sweeping social reform measures in the state's history. By means of a program which included the Little Wagner Act, the Little A. A. A., and taxes based on ability to pay, the Little New Deal emulated its forerunner in Washington. During this period Pennsylvania also abandoned its archaic relief system and set up a modern Department of Public Assistance to care for the needy.

The duration of this reform movement was destined to be brief. Internal conflicts within the Democratic Party, along with charges of corruption against top administration officials, posed a threat to the Little New Deal on the eve of the 1938 election. And there was no help from Washington this time. The New Deal had nearly expanded its energy and, experiencing its first widespread unpopularity, suffered a loss of its own in the Congressional elections. The people of Pennsylvania returned to their normal Republicanism, gave the G. O. P. control of the executive and legislative branches of the state government, and ended the Little New Deal.

The new Republican Governor, Arthur H. James, had waged a virulent campaign against the New Deal in both state and nation, and he was expected to try to eliminate many of the recently-enacted reforms. No sweeping changes occurred, however, and most of the progressive measures of the Earle administration remained on the statute books. While the Little New Deal had been an aberration in the political life of Pennsylvania, it had initiated a shift of power in a direction which could not easily be reversed, though it might be stalled for a time.

Microfilm \$5.40; Xerox \$19.15. 424 pages.

## PURITAN IDEALISM AND THE TRANSCENDENTAL MOVEMENT

(L. C. Card No. Mic 60-5161)

Van-Diem Le, Ph.D.  
University of Minnesota, 1960

Adviser: Jacob C. Levenson

This dissertation attempts to validate the remark often made by historians (Perry Miller among them) that New England Puritanism, like Puritanism in old England, contained a vigorous strain of Renaissance Platonism. By analysing the sermons and writings of a few New England Puritans in the first two chapters, the author shows to what degree these men participated in the Renaissance Platonism which preceded the modern age of reason and became part of the rationalism of eighteenth and nineteenth-century New England. He points out, in the first chapter, in what respect Puritan thought of the seventeenth century foreshadows Lockean philosophy; and, in the second chapter, to what extent it was influenced by Ramism, which is itself a Platonic offshoot. The third chapter, entitled "Activistic Pursuit of Godliness," describes the significance, in the field of conduct and action, of this revived Platonism as it developed within Puritanism and grew into a faith in reason. From this viewpoint the author re-examines Puritan meditation, vocationalism, promotion of corporate life and wariness of the senses, the heart and the artistic life. He argues that these aspects of rational asceticism proceeded from a piety which was rationalistic as well as Calvinist.

In the next three chapters, the author shows how the Transcendentalism of the nineteenth century is not so discrepant in nature from Puritanism, but that the two are related by sharing, to a greater or lesser degree, in the Platonic trend. The intellectual character of Transcendentalism, the ardor of reform which came with it, the growing faith in reason and the shedding of supernaturalism which preceded it, have their source in Puritan culture with its Platonized Calvinism and, in particular, its deep mistrust of the non-rational and historical aspects of human life. Continuing its comparative study of Puritanism and Transcendentalism, the dissertation deals with the questions of how they, as two movements of New England idealism, affected views concerning history, psychology, art, Christianity and culture, and what kind of humanity, society and civilization they tended to promote.

The thesis concludes with a study of Emerson and Hawthorne. These men are not representatives of the type of idealism presented in the preceding chapters; but their variation helps to distinguish the type. Emerson, from the logic of Transcendentalism, developed his conceptions of the universal essence as fluid, and of reason as the power of poetic vision leading to an esthetic mysticism; in his works thought, action, truth and beauty meet beyond all ordinary rationalistic and moralistic distinction. Hawthorne, on the other hand, against the Transcendentalist stirrings of his time, went back deeper into the Calvinist doctrine of depravity; for him it was an ontological and artistic necessity to re-affirm the reality of the imperfect human heart as essential to existence and to art.

Microfilm \$2.70; Xerox \$9.25. 205 pages.



**THE PROGRESSIVES AND THE SLUMS:  
TENEMENT HOUSE REFORM  
IN NEW YORK CITY, 1890-1917.**

(L. C. Card No. Mic 60-6469)

Roy Lubove, Ph.D.  
Cornell University, 1960

A serious housing problem developed in New York City as early as the 1840's. It originated in the lower wards of Manhattan where immigrants concentrated in order to be near their sources of employment and their countrymen. Despite the efforts of the New York Association for Improving the Condition of the Poor (organized in 1843), and the Council of Hygiene, a sanitary reform association responsible for the establishment of the New York Metropolitan Board of Health in 1866, housing conditions continued to deteriorate after the Civil War. The dumb-bell tenement, the most popular form of tenement construction in New York between 1879 and 1901, was testimony to the inadequacy of existing housing regulations.

In 1890, Jacob Riis published *How the Other Half Lives* and emerged as the nation's outstanding housing reformer. Riis was both a prophet and the child of his time. He endorsed the program of restrictive legislation and model tenements (limited-dividend housing) inherited from the AICP and Council of Hygiene. He often adhered to their simple environmental faith, assuming that improvement in the housing of the immigrant and working-class poor would result in radical improvement of their moral and social condition. Yet he had the insight to transcend this limited environmental determinism. Riis understood that the tenement problem did not simply involve housing, but a way of life. Stressing the importance of reconstructing the total environment of the tenement population, Riis viewed the neighborhood, not the house, as the basic unit of sanitary and social control.

However, Riis's ideal of neighborhood reconstruction was not developed by his contemporaries, who veered more sharply than ever in the direction of restrictive legislation. The tenement problem was radically affected by the success of the New York Tenement House Commission of 1900. Lawrence Veiller, Secretary of the Commission and author of its statute abolishing the notorious dumb-bell tenement, assumed local and national leadership of the Progressive housing crusade after 1898. The apostle of restrictive legislation, Veiller minimized neighborhood reconstruction with its parks, playgrounds, schools and similar amenities. Instead, he stressed the drafting and efficient enforcement of housing codes, and a technically proficient, well-organized housing reform movement. A brilliant administrator, Veiller organized the Tenement House Committee of the Charity Organization Society in 1898, the New York City Tenement House Department in 1902, and the National Housing Association in 1910.

After 1909 housing reform partly merged with the vigorous and utilitarian-oriented city planning movement. Both planners and housing reformers like Veiller turned hopefully to England's Garden City and Germany's zoning programs. They emphasized the necessity of urban decentralization in order to relieve the congestion of industry and population responsible for the tenement with its sanitary and social evils.

Apart from legislative accomplishments such as New York's Tenement House Law of 1901 and its zoning reso-

lution of 1916, the outstanding legacies of Progressive housing reform are Riis's ideal of neighborhood reconstruction, Veiller's principle of effective minimum standards through restrictive legislation, and the realization that housing reform is most productive when related to city planning and to urban development as a whole.

Microfilm \$4.70; Xerox \$16.65. 367 pages.

**FALANGE ESPAÑOLA, 1931-1942:  
THE RISE AND STAGNATION  
OF A FASCIST MOVEMENT.**

(L. C. Card No. Mic 60-3127)

Stanley G. Payne, Ph.D.  
Columbia University, 1960

This dissertation is a study of the Spanish fascist movement, Falange Española, from its origins until it was fully tamed by General Franco. It is mainly the history of a political struggle--a struggle of ideologies and personalities.

The national syndicalist idea was first given voice in Spain by Ramiro Ledesma Ramos, a lower middle class intellectual who published a journal called *La Conquista del Estado* in 1931. In October of that year he joined forces with an intensely Catholic zealot for national revolution, Onésimo Redondo, to found the JONS (standing for "Juntas of National Syndicalist Offensive"). The following two years of agitation brought only the merest increase in strength for the group, which had a microscopic membership.

An organized Spanish variant of the fascist-corporatist trend prevalent in Italy was first launched effectively by José Antonio Primo de Rivers, son of the Spanish dictator of the nineteen twenties. José Antonio, as he was called, had few personal characteristics in common with such men as Hitler or Mussolini. He was high-minded, at first averse to violence, and something of an esthete. He dreamed of a grand nationalist regeneration for his country, which he thought was falling into political anarchy. With several collaborators, he founded Falange Española ("Spanish Phalanx") in October, 1933, and the JONS merged with this body a few months later.

The Falange program emphasized a strong national state, an end to political parties and the parliamentary system, and reorganization of all the nation's productive forces into national syndicates. Its propaganda, highly emotional in content, stressed sacrifice, discipline and spirit. The Falange membership was made up mostly of young people from the lower middle class, with a large minority from the working class. Half the movement's following was composed of students under twenty-one. Since the Falange emphasized an economic as well as a political revolution, it was ostracized by the orthodox Rightist parties.

By the time of the elections of 1936 political forces were so polarized between Left and Right the Falange was virtually eliminated as an authentic political movement. Since the party's activists played a leading role in the violence which was now a constant factor in Spanish affairs, the Falange was outlawed in March, 1936, and its leadership imprisoned.

The clandestine Falange, financially supported by the Right but lacking physical strength of its own, had no future save as a follower of the rebellion of July 18, 1936, which was planned and controlled by the Army. The eve of civil war brought a great influx of new members to the movement, though the party's ideology was quite vague in the minds of most adherents. Since the new military regime lacked any consistent program, General Franco, its head, found in the Falange a convenient tool for the construction of a new state. He decided to revamp the movement and make of it his official government party.

José Antonio Primo de Rivers was the only real leader the Falange ever had. He was shot by the Republic soon after the war began. His successors were easily outmaneuvered by Franco, who found it necessary to arrest some of them when he took over the Falange on April 18, 1937. Most Falangists acquiesced in the military dictatorship's control, for patriotism was the only consistent article in the Falange creed, and unity on the Franco side was essential if the war against the Left Republic was to be won.

The opportunists who had joined the party under the pressure of civil war began to drop out after 1939. Some of the original members became embittered when they saw Franco did not intend to effect a real national syndicalist revolution. A number of anti-Franco plots and maneuvers were attempted by Falangists between 1939 and 1941, but they were easily thwarted by the Caudillo. Given the dangerous international situation and the inner divisions of Spain, the old guard Falangists could not find a practical alternative to Franco's rule.

The Caudillo trimmed his sails effectively. By 1942 he was already playing down the authoritarian-fascist element in the Falange, trying to make of it a Catholic-conservative state party. After 1945 it was downgraded still further, and served as nothing more than a bureaucratic hodge-podge to frustrate the monarchists and maintain the delicate balance of the regime. In the nineteen fifties the Falange no longer existed as a political force, but only fluttered as a large scarecrow in the dusty garden of Franco Spain.

Microfilm \$5.85; Xerox \$20.75. 458 pages.

#### THE COLONIAL THEATRE; ITS HISTORY AND OPERATIONS.

(L. C. Card No. Mic 60-4860)

Hugh Franklin Rankin, Ph.D.  
The University of North Carolina, 1960

Supervisor: Hugh T. Lefler

The theatre was slow in coming to the English colonies; it was a luxury which had no place in the daily desperate struggle for survival. But once daily life assumed some of the aspects of civilization, the colonists turned to the drama for entertainment. As early as 1665 three young men of Accomac County on the Eastern Shore of Virginia were haled into court for their amateur attempts at play presentation. And there were others, in other colonies, who succumbed to the lure of the stage and strutted before their fellows in amateur efforts.

The first serious attempt at an established theatre occurred sometime between 1716 and 1720, when William Levingston built and operated the first formal theatre in the colonies in Williamsburg, Virginia. Apparently using indentured servants as actors, Levingston operated for several years before becoming overwhelmed by his debts.

In a like manner, a group of stage-struck persons in Charleston, South Carolina, began operating a theatre which met a reasonable amount of success; the response was great enough to encourage the construction of a formal theatre in that city in 1736.

In 1748, a "pick-up" company originated in the vicinity of Philadelphia and for the next four years they managed to elude their creditors before final insolvency in Annapolis in 1752. This company, under the direction of Walter Murray and Thomas Kean, played Philadelphia, New York, and Williamsburg prior to their final fade-out in the Maryland capital.

The year 1752 marked the beginning of the professional theatre in the English colonies. The London Company of Comedians, under Lewis Hallam, Jr., landed at Yorktown, Virginia, June 2, 1752. They began their American operations in Williamsburg September 15, 1752, with a presentation of *The Merchant of Venice*. Lewis Hallam died in Jamaica within the next two years, but his widow soon married David Douglass, who carried on as manager of the company.

From this time on this company, eventually to change their name to The American Company of Comedians, ranged the American mainland, their basic itinerary including the towns of Williamsburg, Charleston, New York, Philadelphia and Annapolis. These were the towns most receptive to the players, although they did play shorter seasons along the way, and were even bold enough to make one abortive assault upon New England. In those areas where a theatre building did not exist, they performed their plays in courtrooms, council chambers, warehouses, and even a hospital.

In 1774, when the outbreak of war appeared inevitable, the actors scurried to Jamaica, there to sit out the hostilities.

The second section of this dissertation is concerned with the operations and customs of the colonial theatre; it includes an appendix containing a discussion of the acting styles of the day. Sources are sketchy in this field, and many of the practices of the players had to be drawn by implication from newspaper advertisements, vague references in letters or memoirs, or passing references in diaries. It was determined that many of the theatrical practices of England were carried over into the colonies, which led to a search of English writings on the theatre. The acting styles of the eighteenth century were drawn from several manuals of the day which were in print and probably available to Lewis Hallam and his players.

Although it was never a financial success, the colonial theatre was able to act as an agent of transition in bringing a facet of English culture and entertainment to the American colonies. Microfilm \$6.85; Xerox \$24.30. 540 pages.



THE ROLE OF THE CONTINENTAL CONGRESS  
IN THE PROSECUTION OF  
THE AMERICAN REVOLUTION  
IN PENNSYLVANIA

(L. C. Card No. Mic 60-5456)

Helen E. Royer, Ph.D.

The Pennsylvania State University, 1960

The Continental Congress played a more direct and more vital role in the prosecution of the American Revolution in Pennsylvania than in any other State. In many respects Congress, more than the government of Pennsylvania directed the State's war efforts. This distinctive situation developed from a combination of factors: (1) the nature of Pennsylvania's problems, (2) the attitude of the Pennsylvania executives, and (3) the geographic location of Congress.

Pennsylvania's problems, which were greater than those of any other state, resulted from the prolonged struggle between the supporters and opponents of the Pennsylvania Constitutions of 1776, from the large number of Tories and pacifists within the State, and from the weakness of Pennsylvania's ultra-democratic government. Although Pennsylvania, or at least a vociferous portion of the city of Philadelphia, had been a leader in the American movement to secure redress of grievances from the British government, when the American program changed from the constitutional approach to revolutionary measures, dissension rent the State. This internal conflict at times tended to dwarf the issue of the war, frequently hampered war measures, and occasionally paralyzed the government completely.

President Thomas Wharton, Jr., and later President Joseph Reed leaned heavily upon Congress because of the constitutional weakness of their position. Except on those rare occasions when the State's rights were threatened by acts of Congress, the Pennsylvania executives did all within their power to follow Congress' directives and to fulfill its demands for men, money, and supplies.

Equally important in explaining the close relationship which developed between Pennsylvania and Congress was the physical proximity of Congress to the Pennsylvania revolutionary bodies. Frequently, committees of Congress conferred directly with the Pennsylvania executive authorities and with the Assembly, entreating help, suggesting means by which the State could act, and sometimes promising Congressional assistance. Moreover, Congress as a body and the delegates as individuals were in constant touch with the Pennsylvania populace. Congress' backing enabled the radicals to seize control of the Pennsylvania government. It saved the State government from collapse during periods of military crisis, and it largely directed the State's war efforts by its recommendations, requests, urgings, and chidings.

Despite the severe handicaps under which the government labored, Pennsylvania with Congressional assistance and compulsion made significant contributions to the American cause. In matters of provisions, wagons and teams, and supplies for the army, Pennsylvania was a mainstay of the war effort. In the field of defense, Pennsylvanians rendered some of their most meritorious service through the State Navy and the defense of the Delaware River.

The need for Congress' direction and the attempts by

the Pennsylvania authorities to co-operate with Congress and to fulfill its requests, constitute the core of this study of Pennsylvania revolutionary activity. Leading personalities appeared and faded throughout the period, conservatives and radicals alternated in power, and the form of the executive changed several times. The major exertions of the State shifted from defense of Philadelphia and vicinity in 1776-1777, to protection of the frontiers in 1778, to financial problems in 1779, to the specific supplies system in 1780, and to mutinies of portions of the Pennsylvania Line of the Continental Army in 1781 and 1783. The one thing which remained constant throughout the entire period was the close co-operation between Pennsylvania and Congress. Without Congress' presence in the State, its supervision, and occasional intervention, the Pennsylvania Commonwealth, rent by internal conflict, might have fallen easy prey to the British. That Pennsylvania did contribute its share to the common cause seems to have been due largely to the constant impellent action of the Continental Congress.

Microfilm \$4.95; Xerox \$17.35. 385 pages.

THE LONDON NEWSPAPERS  
AND BRITISH POLITICS:  
A PERIOD OF TRANSITION, 1880-1895.

(L. C. Card No. Mic 60-4726)

Harry George Schalck, Ph.D.

Clark University, 1960

The years 1880-1895 were a time of ferment and change for England and the Empire. The British newspaper press, and especially the London daily press, not only recorded but took part in these political, social, and economic changes.

The unique characteristics of this era--the period of the "New Journalism"--were based on certain technological advances in the printing industry, and upon the editorial practices inaugurated by two gifted and erratic individuals, W. T. Stead, of the Pall Mall Gazette, and T. P. O'Connor, of the Star. Both men reflected the widening concern of "politics" with social and economic questions, and they made use of the personal interview, illustrations and political cartoons, and, above all, leading articles written in a light style. They influenced other London papers in varying degrees, including the venerable Times, the blue-Tory Morning Post, the Standard, the widely-read Daily Telegraph, the doctrinaire Liberal Daily News, and the Daily Chronicle. Since all eight papers had a combined circulation of less than a million, however, it is obvious that most ordinary Englishmen did not read them. Yet their editors hardly cared, for government policy was still made and watched by a political, social, and intellectual elite.

And how did these people who counted view the world? Most papers approved franchise extension, but the Conservative ones deplored the voters' popular choices for the new London County Council, and only the most Radical dared support the mass meetings of dissatisfied men in Trafalgar Square. In several campaigns for social legislation--especially the movement to amend the criminal law--the Pall Mall stood in the van in both methods and



ideas. On the Home Rule question the newspaper world found itself even more split, until it became impossible to write coolly on the merits of non-Irish issues. This spirit led The Times to print the Pigott forgeries, and temporarily made allies of Stead and Charles Stewart Parnell, as well as of the Morning Post and Joseph Chamberlain. Yet the opposition of the majority of the press to Home Rule was undoubtedly an accurate reflection of English opinion in general.

In foreign and imperial affairs most papers--the Daily News and the Star excepted--were nationalistic. The occupation of Egypt, the mission of Gordon to the Sudan (for the choice of Gordon the Pall Mall was directly responsible), and the retention of Uganda were all approved or partly motivated by the press. Stead's attitude of appeasement towards Russia at the time of the Penjdeh crisis was a rare and unpopular exception.

Finally, the confusing and even alarming question of national defense was taken up by the press, notably The Times, the Pall Mall, and the Daily Telegraph, who led the push for a stronger Navy and revamped Army. This resulted in several naval and invasion "scares."

In certain important events of these years we see, then, advanced and sensational journalistic practices interacting with similar political methods. The new habits, however, were the work of men of integrity and principle, men like Chamberlain, Stead, and Cecil Rhodes, who sometimes appeared from outside the established ranks of political and social leadership. Yet their goals were more lofty than mere political success or the simple accumulation of money and power. Both politicians and journalists felt a responsibility toward the public, a responsibility heightened by their living in an era of confusing change at home and abroad. Microfilm \$3.90; Xerox \$13.75. 301 pages.

AGRARIAN IDEOLOGY  
AND THE FARM PROBLEM  
IN NEBRASKA STATE POLITICS  
WITH SPECIAL REFERENCE  
TO NORTHEAST NEBRASKA, 1920-1933.

(L. C. Card No. Mic 60-5582)

James A. Stone, Ph.D.  
The University of Nebraska, 1960

Adviser: Dr. James C. Olson

This dissertation is a study of the reactions of a basically agrarian area in an industrialized society. It considered the problem as it affected northeast Nebraska from 1920 to 1933. Nineteen-twenty witnessed the beginning of a long period of economic dislocation in the farming areas that did not end until World War II once more inflated farm prices. During the period from 1920 to 1933 two basic approaches leading to the solution of the farm problem can be recognized. These are the neo-Populist solution and the business-oriented solution. Those favoring the neo-Populist solution looked upon the problem as one that could be solved only when a method was found to force upon all business the same degree of competition as that experienced by the farmer. Those favoring the business-oriented solution looked upon the problem as one that could be solved

only when a method was found to give to the farmer some degree of monopolistic control over markets as that developed in many areas of business. The neo-Populist solution usually originated on the local level and attempted to create support for its program on the state and national level. The business-oriented solution usually developed on the national level and attempted to create support for the plan among local leaders of the farming community.

After attempting to define the differences and similarities between those two positions, this study presents an analysis of the interreaction of the two points of view in solving the economic, social and political problems created in northeast Nebraska by the collapse of the farm price structure in 1920. In the early Twenties the neo-Populists attempted to solve the problem through third party activities. During the early Thirties this group was very active in the famous Farm Holiday movement. The business-oriented group in the middle Twenties attempted to solve the farm problem through the McNary-Haugen plan and Hoover's Farm Board. Although in the same tradition, the McNary-Haugen plan and the Farm Board engendered a bitter factional struggle within the Republican party in Nebraska.

During the entire period from 1920 to 1933, the neo-Populist program, under the impact of the growing agrarian crisis, was transformed from one that supported a broad program of social, political, and economic reforms to one that was basically narrow, localistic, and parochial in nature. Demands for broader reform gave way to demands for local controls over taxation and schools; solutions that emphasized local action and eschewed any positive aid from the state government were proposed by neo-Populists to meet the serious debt and mortgage problems caused by grasshopper plagues and drouth. Even those programs developed by third parties and the Farm Holiday movement were interested in using government action only to control other sectors of the economy, leaving the farmer free to carry on his activities without interference by either big government or big business. The neo-Populist ideology failed to reconcile that part of the ideology that demanded that government do something to protect the interests of the farmer with that part which was unwilling to give up independence to some agency beyond the immediate control of the individual and the community.

Microfilm \$5.80; Xerox \$20.50. 453 pages.

THE MOVEMENT TO PROVIDE  
IMPROVED WORKING-CLASS HOUSING  
IN ENGLAND, 1840-1860.

(L. C. Card No. Mic 60-4874)

Frank LeRoy Turner, Jr., Ph.D.  
The University of North Carolina, 1960

Supervisor: James Logan Godfrey

In the century before 1860 the English population trebled in size, and the industrial revolution introduced the factory system of production. The factories attracted rural labor from the countryside and helped to make England highly urban. By 1860 over one-third of the English population lived in towns of 20,000 inhabitants or more. The rapid



increase in the size and number of towns led to difficulties in local government. Local government in England in the mid-nineteenth century was a patchwork of town councils and ad hoc boards and commissions, and deficiencies in local government led to the uncontrolled growth of towns which in turn resulted in bad drainage, polluted water, and the growth of slum areas.

The social reform movements of nineteenth-century England attempted to adapt the institutions of pre-industrial revolution England to the new urban industrial society. Nurtured in the ideas of Adam Smith and Jeremy Bentham, the influential classes distrusted the state as an agent of social amelioration. The ruling classes believed that real social improvement could come only through increased productivity and the encouragement of privately-sponsored movements which would improve the working classes through self-help. Called to their effort by the growing awareness in the 1840's of the deplorable condition of the working classes, the housing reformers therefore began their work through private voluntary societies. The Metropolitan Association for Improving the Dwellings of the Industrious Classes and the Society for Improving the Condition of the Labouring Classes built model dwellings to find out whether such housing would be healthful and whether it would produce sufficient profits to interest private entrepreneurs in building model dwellings and thus initiate housing reform by capitalistic means. The model dwellings proved to be healthful, but they did not produce enough profit to attract commercial capital. To tap new sources of capital the housing reformers helped to enact the limited liability acts of 1855-1856. Although new com-

panies were formed with limited liability, they could neither make attractive profits nor provide housing at rents cheap enough for the lower strata of the working classes.

To supplement the work of private enterprise Shaftesbury enacted the Labouring Classes Lodging Houses Act of 1851 which permitted local authorities to construct municipally-owned housing. The almost complete disuse of this act demonstrated that local authorities were disinclined to spend money on social reforms. Shaftesbury also sponsored the Common Lodging Houses Acts of 1851 and 1853. By giving the term "common lodging house" a broad definition Shaftesbury hoped to put a major portion of working-class housing under regulations of sanitation and occupancy and thus control overcrowding. Parliament limited the jurisdiction of the acts more narrowly than Shaftesbury wished, but the acts were successful in operation because they were obligatory on local authorities and were carried out by civil employees responsible to the central administration. Shaftesbury was unsuccessful in his attempt of 1857 to put a larger portion of working-class housing under the surveillance of the lodging house inspectors because of the strenuous opposition of the landlords. The lodging houses acts were not to be the means by which overcrowding was to be regulated.

English housing reform in the years 1840-1860 proved that private enterprise could not in practice provide enough acceptable housing for all strata of the English working classes. Housing reformers began to look toward the state to regulate overcrowding and supplement the work of private enterprise in providing dwellings.

Microfilm \$4.10; Xerox \$14.40. 320 pages.

## HOME ECONOMICS

### INFLUENCE OF AGE AND BODY WEIGHT ON ENERGY EXPENDITURE OF WOMEN DURING CONTROLLED PHYSICAL ACTIVITY

(L. C. Card No. Mic 60-5884)

Florence Langford, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: Dr. Wilma D. Brewer

The influence of age and of body weight on energy expenditure of women during controlled physical activity was investigated. Thirty-five apparently healthy women, selected according to age and body weight, were subjects for treadmill walking at a four per cent incline and at speeds of two and three miles per hour. The subjects were distributed among five groups with seven in each group. Young women, 25 to 34 years of age (mean age, 29.7 years) and of desirable body weight for height served as the reference group; two groups of women, also of desirable body weight, had mean ages of 49.4 and 69.4 years, respectively. Two groups of women were comparable in age to the reference group but were underweight and overweight, respectively.

Energy expenditures were studied by methods of indirect calorimetry using the Kofrányi-Michaelis respirometer with measurements of oxygen uptake and carbon dioxide production. The mean basal energy expenditure for the reference group was 2.96 Cal./kg<sup>0.73</sup>/hr. Mean values for the middle aged and the older women were significantly less by 6.8 and 14.9 per cent, respectively. The basal metabolism of the underweight women was similar to that of women of desirable body weight; the mean value was 2.97 Cal./kg<sup>0.73</sup>/hr. Overweight women averaged 2.63 Cal./kg<sup>0.73</sup>/hr., significantly less than the basal heat production of women of desirable or less than desirable body weight. Basal energy expenditures, expressed as Calories per hour, did not differ significantly among the three age groups but increased significantly with mean increments in body weight.

Statistical analysis indicated that age did not influence the energy expenditure during walking. Energy expenditures for the three age groups were similar when expressed as Calories per hour and also on the basis of body weight. The increment in energy expenditure during walking above energy expended at bed-rest also was similar for the three groups of women of different ages.

Mean energy expenditures during walking were 171,

204 and 230 Cal./hr. at two miles per hour and 212, 250 and 290 Cal./hr. at three miles per hour for the underweight, average weight and overweight women, respectively. Differences among the three groups were statistically significant. Energy expenditures, expressed in terms of a unit of metabolically effective body size, averaged 9.68, 10.79 and 9.96 Cal./kg<sup>0.73</sup>/hr. for walking at two miles per hour and 11.96, 13.26 and 12.50 Cal./kg<sup>0.73</sup>/hr. for walking at three miles per hour for underweight, average weight and overweight women, respectively. On this basis, the underweight women differed significantly from the women of average weight but not from women who were

overweight. Differences between the average weight subjects and the overweight subjects were not significant.

The experimental findings indicated that basal metabolism of women was influenced by age and by body weight. The energy expenditure for physical activity was influenced directly by body weight. There was a tendency toward an increase in mean body weight with a mean increase in age for the young, middle aged and older women, although all were judged to be desirable in body weight for their height. The metabolic cost of physical activity apparently was not influenced by age apart from the concomitant increase in body weight. Microfilm \$2.50; Xerox \$7.00. 147 pages.

## LANGUAGE AND LITERATURE

## LANGUAGE AND LITERATURE, GENERAL

THE APPRENTICESHIP OF GEORGE MOORE:  
HIS RESPONSE TO CULTURAL INFLUENCES.

(L. C. Card No. Mic 60-5078)

Mildred Davis Adams, Ph.D.  
Columbia University, 1960

All of George Moore's works, his novels no less than his autobiographies, tell of his greedy but selective use of his cultural environment in an intense cultivation of himself as man and artist. This self-cultivation was Moore's long struggle to reconcile a tension in himself--as he variously conceived it--between fact and poetry, the visible world and the ideal, reality and romance, home and adventure, world and cloister, flesh and spirit. Because of this tension the young Moore was drawn to varied and apparently antagonistic scenes and masters. From it sprang the characters, plots, and styles of his early books--books which have earned him a prominent place in the literary history of both realism and symbolism. Out of it came the synthesis recorded and achieved in *The Lake* and characteristic of all his subsequent works.

The purpose of this book is to trace Moore's personal and literary apprenticeship from *A Mummer's Wife* (1884) to *The Lake* (1905) and especially to indicate his responses to his cultural environment--the aestheticism and decadence of the *fin de siècle* in France and England and the renaissance in Ireland.

Chapter I deals with *A Mummer's Wife*. Written after his formative years in France and after several prophetic experiments in verse, drama, and fiction, *A Mummer's Wife* is crude, powerful, deliberately naturalistic, and unconsciously personal. Though fairly successful, it represents no satisfactory point of view or style for Moore.

The next four chapters deal with Moore's subsequent works written in England at the end of the century (*Drama in Muslin*, *Mere Accident*, *Confessions*, *Spring Days*, *Mike Fletcher*, *Impressions and Opinions*, *Vain Fortune*, *Modern Painting*, *Strike at Arlingford*, *Esther Waters*, *Celibates*, *Evelyn Innes*)--works which show Moore growing in self-knowledge and moving toward a more personal content and style under the influence of philosophy (Chapter II),

painting (III), music (IV), and literature (V). Permanently influenced by Nietzsche and Schopenhauer in his extreme individualism, his cult of the irrational, and his almost religious aestheticism, Moore applied their lessons, especially Schopenhauer's, successfully in the introspective *Confessions* and clumsily in the speculative novel *Mike Fletcher*. From painters and their work, especially Manet, Degas, the Impressionists, Corot, and Whistler, Moore, whose visual imagination was always strong, learned much about art in general and himself, and he showed his increased understanding in his highly pictorial writings. To music, especially Wagner, he owed more in this period than is generally recognized. *Spring Days* is apparently an elaborate experiment in a musical "prelude" woven of leitmotifs, and *Evelyn Innes* represents a deepening and clarifying of Moore's personal mythopoeic vision under Wagner's influence. Though Moore's relationship to the French realist writers remained important, he gained much from Pater; the French symbolists, particularly Huysmans and Dujardin, and their English-speaking kinsmen Symonds and Yeats; Ibsen; and the Russian novelists, particularly Turgenev. Of all these writers, it was probably Dujardin and Turgenev who influenced Moore most significantly in this period.

The last chapter (VI) deals with the works written during Moore's renaissance in the larger renaissance of Ireland, *Sister Teresa*, *The Untilled Field*, and *The Lake*. Stirred by the Irish literary movement and the life, language, folk-lore, and landscape of his native land, Moore grew to a personal and literary maturity in which the lessons of his masters were assimilated and the tension was reconciled.

Microfilm \$3.05; Xerox \$10.60. 234 pages.



**A STUDY OF ARTHUR MURPHY'S  
GRAY'S-INN JOURNAL (1752-1754)**

(L. C. Card No. Mic 60-4824)

Roy Edwin Aycock, Ph.D.  
The University of North Carolina, 1960

Supervisor: Richmond P. Bond

The purpose of this study is to describe Arthur Murphy's Gray's-Inn Journal in terms of the bibliographical facts of its publication, the journalistic traditions to which it belonged, its editorial policy and authorship, its contents, and its forms and devices.

The first forty-nine numbers of the Gray's-Inn Journal appeared in 1752-53 as a column in a weekly paper called the Craftsman; these issues have not survived. Murphy left the Craftsman and published fifty-two new numbers of the Gray's-Inn Journal as a separate periodical (September 29, 1753 - September 21, 1754). These numbers were bound with a title page dated 1754. Added to those that had appeared in the Craftsman, they brought the total to one hundred and one. In 1756 Murphy re-issued the journal in two volumes of fifty-two numbers each, a total of three more numbers than had originally appeared. Only six of the forty-nine numbers from the Craftsman can be positively identified; the disposition of the other forty-three numbers must remain a matter of conjecture. The 1756 edition is quite different from that of 1754: dates are changed, issues are rearranged, texts are different. A typical issue of both these editions consists of the essay proper and a section called "True Intelligence," which is a repository of news, letters, verse, and miscellaneous trivia. In 1786 Murphy published the last edition of his journal. Again the revisions are drastic: the "True Intelligence" section is all but eliminated, dates are altered, essays are moved about, the style is different.

The use of the eidolon, Charles Ranger, is described in the present study. The editorial policy of utile and dulce is placed in the tradition of the Tatler and Spectator. A desire to aid Fielding and Smart in their attacks on Hill's Inspector papers and a desire to praise Garrick are suggested as Murphy's practical reasons for starting a journal. Though there was never any secret about the identity of Charles Ranger, Murphy does not sign his real name until the end of the 1756 edition.

The journal, again in the Spectator tradition, is concerned with morals and manners. Such vices and follies as duelling, gaming, lying, scandal, and pride are subjected to various forms of satire in an effort to make morality fashionable. There is little formal philosophy. The most significant feature of the journal, and its chief claim to distinction, is literary criticism. In the treatment of the epic, tragedy, and especially comedy, Murphy proves himself a neo-classicist. His remarks on the bases of comedy are particularly impressive. Much attention is given to Shakespeare: plays are interpreted, passages are explicated, emendations are offered. Appraisal of contemporary drama is frequent. On one occasion only does Murphy concern himself with politics.

The major forms are the essay (frequently in the guise of a letter), fiction in the shape of Oriental tales and dreams, dramatic pieces, the Character, and a single dialogue. The most frequent form is the essay, which is classified as formal, mock-formal, and informal. The

informal essays are classified as discursive, chronological, and climactic. Auxiliary or minor forms, embedded in the major forms and used for illustrative purposes, are extracts from diaries, excerpts from a Hebrew Journal, letters, itemized rules for behavior, specimen from a dictionary. Letters to Ranger and verse, both inconsequential, were banished in 1786 along with the "True Intelligence" section.

Murphy's special devices are the club, tribunal, motto, and serial and series. The Club of Originals, of which Ranger is a member, is Murphy's version of the Spectator Club; the Robin Hood Society is used for satiric purposes. The tribunals are the Court of Censorial Inquiry used to chastise social improprieties and a Board of Criticism used to scourge contemporary critics. The motto is used for foreshadowing. The serial and series achieve intermittent unity and coherence.

Appendix I is a brief survey of the Craftsman from its start up to and including its connection with the Gray's-Inn Journal. Appendix II contains two charts: one shows the numbers under which each essay appears in all three editions; the other is a collation, in parallel columns, of an essay in its three versions.

Microfilm \$2.95; Xerox \$10.35. 226 pages.

**THE HISTORY OF PHILOSOPHY  
BY THOMAS STANLEY:  
A CRITICAL STUDY.**

(L. C. Card No. Mic 60-4825)

Howard Wilson Bahr, Ph.D.  
The University of North Carolina, 1960

Supervisor: Almonte C. Howell

The purpose of this investigation was to examine The History of Philosophy against the background of the seventeenth-century scientific renaissance and thereby to arrive at a revaluation of this work. Two major streams of influence were found to have been instrumental in its production: (1) the French philosophers and scientists, Gassendus in particular, who were the first true disciples of Francis Bacon and who revived the Atomistic philosophy of Epicurus, and (2) the corresponding group of English Baconians who were later to form the Royal Society.

In addition to demonstrating that this work of Stanley was in the main stream of the New Science movement of the second half of the seventeenth century, the initial phases of this study undertook a canvass of the available materials for a biography of Stanley and a compilation of a bibliography of The History of Philosophy. The latter revealed that although no edition of Stanley's History appeared after the fourth in 1743, sporadic interest in the work has resulted in reprinting of portions of it as late as the first years of the twentieth century.

A consideration of earlier works which had to some extent dealt with the history of philosophy produced evidence that Stanley's History, the first English treatment of the subject, exceeded in scope the work of Diogenes Laertius and the more recent partial accounts. Passages in Stanley's work reveal that he was attempting to answer Bacon's call for a just account of the learning

of the ancient Greeks and to produce the "Register" of the opinions of the old philosophers that Montaigne had desired.

An intensive examination of *The History of Philosophy* disclosed that Stanley had additional purposes which he wished to fulfill. His methods and use of source materials indicate that he intended the work to serve as a useful compendium and gentleman's handbook of the lives, learning, and opinions of the ancient wise men. More particularly, the large amount of material derived from Lucretius indicates that Stanley attempted to provide English readers with a full account of the Atomistic philosophy of Epicurus.

Through analysis of the original portions and the translated parts, both in prose and verse, the work was examined as a literary production. The evidence tended to show that while in general Stanley subscribed to the principles of the simpler utilitarian prose advocated by his Royal Society colleagues, yet as a prose stylist he was undistinguished. His poetic translations, however, were of a uniformly higher quality than his prose. In spite of its ostensible nature, *The History of Philosophy* is a literary work, not because of its value as a prose document, but because of the many well-executed passages of translation. Those in prose are adequate, but many of the verse translations have considerable merit and reveal that Stanley the poet was much more competent than Stanley the prose writer.

The reputation of Stanley and his *History of Philosophy* was found to have deteriorated progressively until this once highly respected work is either disregarded or the author's intention misunderstood. Although his work is not important today as a history of philosophy, he deserves a place in the seventeenth century beside such men as Burton and Browne, writers who made science and philosophy available to a wide range of readers. First of all, he presented the history of the learning of the Ancients, both the Greeks and the Chaldeans, in an account which was entertaining as well as instructive. Secondly, by his extensive treatment of the philosophy of Epicurus and Lucretius he made a definite contribution to the New Science by popularizing among English readers the Atomistic philosophy upon which modern science was founded.

Microfilm \$3.10; Xerox \$10.80. 238 pages.

#### SWINBURNE'S MARY, QUEEN OF SCOTS, AND THE HISTORICAL MARY.

(L. C. Card No. Mic 60-4648)

Grace Hadaway Boswell, Ph.D.  
University of Georgia, 1960

Supervisor: Edwin M. Everett

The purpose of this study was to analyze the character of Mary, Queen of Scots, as portrayed in Algernon Charles Swinburne's trilogy (*Chastelard*, 1865; *Bothwell*, 1874; and *Mary Stuart*, 1881) and to compare the Mary of these plays with the Mary of history. The author hoped also to arrive, through such a comparison, at some interpretation of Swinburne's possible attitude toward the heroine whom he depicted.

To arrive at conclusions concerning Mary's character,

the author studied and discussed the Scottish Queen in six roles in which she appears in Swinburne's plays: first as the youthful ruler of Scotland, widow of Francis II of France; secondly, as the wife of Henry, Lord Darnley; next as mistress and later wife of James Hepburn, Earl of Bothwell; then as captive of her people and fugitive from them; again as the enemy of the Reformer John Knox; and finally as prisoner of Elizabeth in England. An effort was made to compare Swinburne's treatment of Mary in each of these situations with the treatments of historians. Particular attention was given to the works of John Hill Burton, James Anthony Froude, and John Knox, whom Swinburne acknowledged as sources. The author studied Swinburne's own article on Mary in the *Encyclopaedia Britannica* to search for similarities and differences between the Mary revealed there and the Mary of the dramas.

The conclusion reached was that, although the Mary of the trilogy is much like the historical Queen of Scots, Swinburne takes several traits of the historical Mary and exaggerates them in his dramatic heroine. These exaggerated traits which appear in Mary throughout the trilogy are the following: a selfish, demanding attitude, which involves a haughty insistence on her absolute rights as a sovereign and particularly an insistence that lower-born women sacrifice for her; an intense unhappiness that manifests itself sometimes in dolorous sighs and sometimes in words and acts of vengeance; a crafty reliance on men to do her bidding, to make decisions for her in matters of state and to scheme for the realization of her personal desires; and all the attributes of the *femme fatale*, a woman beautiful and desirable, but fatal to those men whose lives become involved with hers.

The portrayal of Mary in the trilogy reveals that Swinburne's own attitude toward Mary was that she was guilty of much sin but that she endured much suffering and that she was, as a result, a greater person than she would otherwise have been. The poet disagrees with those who would describe Mary as a dupe and an innocent fool. He sees her, instead, as a woman longing for freedom to live as she pleases and daring to act as if she has that freedom. He seems to make his Mary symbolize his own metaphysical principle of freedom in personal behavior and in artistic expression, a principle which became, to him, almost synonymous with soul and with deity.

Microfilm \$3.15; Xerox \$11.05. 244 pages.

#### A METRICAL TRANSLATION OF *GREGORIUS, THE GOOD SINNER*, BY HARTMANN VON AUE WITH CRITICAL AND INTERPRETIVE NOTES.

(L. C. Card No. Mic 60-5418)

Sheema Sylvia Zeben Buehne, Ph.D.  
The Pennsylvania State University, 1960

This is a translation into English metrical form of *Gregorius, the Good Sinner*, the twelfth-century Middle High German religious epic of Hartmann von Aue. The distinctive features of this translation are:

1. It is complete, in iambic tetrameter rhymed couplets. (The translation made by Edwin H. Zeydel



in collaboration with Bayard Quincy Morgan omits approximately one-twentieth of the text).

2. It was made after intensive study of the variant readings, particularly with respect to the much-disputed Prologue.
3. The effort was made to give Hartmann's linguistic nuances in as clear and true English as possible, without any distortion of English idiom. Further, the attempt was made to recreate not only his simplicity and naive dignity of style, but his ambiguity, sophistication, profundity, and humor as well.
4. A chart showing the variants of the Prologue accompanies the translation.
5. An introductory chapter presents the problems of translating the Middle High German of Hartmann's *Gregorius* into English metrical form.
6. A chapter of extensive Critical and Interpretive Notes attempts to do the following:
  - a. To indicate the choice of the variant reading used
  - b. To clarify difficult passages.
  - c. To furnish references to scholarly work in philology, literary criticism, etc., pertinent to significant words and concepts in the epic.
  - d. To indicate where existing translations do injury to the meaning of the original Middle High German.

The epic exemplifies the teaching of the church: Sinful man, no matter what his crime, if he but have faith, may obtain the grace of God and his own salvation through true repentance and expiation.

Atoning for the sin of his brother-sister parents, and for his own oedipal marriage, entered upon in ignorance, cloister-trained *Gregorius* spends seventeen years in solitary penance upon a deserted island. He is then miraculously acclaimed pope of Rome through the intervention of the Paraclete.

The epic, in the present translation, is made available in its entirety in the English language, so that it can be evaluated both as a religious legend and as a literary work of the period. Since the subject matter of miracles, even in a jet and rocket age, lends itself easily to ridicule, it is important to reproduce the reverent and sincere tone of the original. This the translation attempts to do.

A bibliography is included.

Microfilm \$4.00; Xerox \$14.20. 312 pages.

**THE NEW FEUDALISM:  
THE MIDDLE AGES AS A SOCIAL AND  
POLITICAL IDEAL IN EARLY  
NINETEENTH-CENTURY ENGLISH LITERATURE.**

(L. C. Card No. Mic 60-5084)

Alice Kogan Chandler, Ph.D.  
Columbia University, 1960

The "new feudalism" was an attempt to solve the problems of an increasingly chaotic industrial society by an

appeal to the ordered world of the medieval past. Like other aspects of the medieval revival, it was part of the general change of taste from classic to "gothic" that occurred toward the end of the eighteenth century and was particularly indebted to the recently developed scholarly interest in the middle ages. The new feudalism, however, also grew out of the matrix of society itself. Faced with the suffering and ugliness resulting from the Industrial Revolution, the man who had been young in 1800 tended to look back with nostalgia to the England of his youth--an England which with its communal agriculture, archaic customs, and ancient modes of local government was still in many ways medieval.

For certain types of mind, youthful recollections and the prevailing taste for things medieval became part of a general pattern of conservatism. Convinced that man was essentially an irrational being who needed to be guided by "illusions" and traditions, many romantics found such guidance in the customs and feudal leadership of the middle ages. Perhaps the best word with which to describe their imagined middle ages is paternalistic, for they stressed the care that the strong and wealthy took of the poor and weak and, as a corrective to the predominant belief in *laissez-faire*, offered the ideal of a regulated and cooperative community.

Scott is the seminal figure for this study. In him the gothic revival of the eighteenth century ends and the new feudalism of the nineteenth century begins. Although he does not himself make the medieval-modern contrast, his picture of the middle ages is so vivid that few later writers can avoid his influence. The first medievalists to employ the past extensively as a corrective for the present are Coleridge, Wordsworth, Southey, and Cobbett. Sometimes they use it to argue on specific issues, such as the New Poor Law or Parliamentary reform. More often, however, they use it to teach more general and gravely needed truths: to remind their century that a sturdy yeomanry rather than a miserable and degraded proletariat once formed the backbone of English society.

Until Carlyle, all medievalists thought that the lot of the poor was to be remedied by an agricultural aristocracy. Believing the nation still agrarian, they thought that the condition of England could be bettered by the ministrations of kindly landlords and by a partial return to the traditional forms of landholding. Carlyle, however, showed that medievalism was not necessarily the philosophy of an agricultural society alone. Born about twenty years after our earlier medievalists and familiar with the industrial North, he managed in *Past and Present* to apply the new feudalism to an industrial society. By making their factories healthy, giving their workers permanent contracts, and sharing their profits with them, his Captains of Industry were to show the same responsibility toward their workers that earlier medievalists had wished the landlords to show their tenants.

The relation between medievalism and recent history's more paternalistic views of the roles of industry and the state also appears in the writings and actions of Disraeli and the Young England party, who applied the principles of the new feudalism to specific legislation. The Young England program in Parliament from 1842 to 1845 and the social reforms of Disraeli's long ministry, 1874 to 1880 are both examples of medievalism in action and show, once again, that scholarship and literature can have practical effects upon history.

Microfilm \$3.90; Xerox \$13.75. 303 pages.

THE POETRY OF  
HENRY HOWARD, EARL OF SURREY.

(L. C. Card No. Mic 60-4640)

Charles Willison Eckert, Ph.D.  
Washington University, 1960

Chairman: William A. Ringler

This partial edition of Surrey's poetry does not include the text of his Virgilian translations or critical notes to the poetry. For the 54 poems it includes it provides a critical text with apparatus, textual notes, and a full study of the provenance and authority of all sources.

In the Critical Introduction I attempt to show that Surrey was more heavily influenced by contemporary "poesia per musica" than by purely literary models and that the majority of his poems are intended for musical settings, including those written in poulter's measure. The latter form was invented by Wyatt, probably in imitation of the canzone as it was modified in musical settings; and Surrey, who took the form from Wyatt, apparently thought of it as suitable for song-lyrics. Next, Surrey's debts to Chaucer and to contemporary imitators of Petrarch are shown to be greater than his debt to Petrarch. Surrey's prosody is also studied and is shown to be heavily influenced by the humanist reaction against rhyme, intricate stanzaic forms, and short lines, and less regular than it has been believed to be (irregularities in the copy-texts have been masked by previous editors who either emended the poetry or chose to follow the most regular text).

In the Textual Introduction I demonstrate that the Arundel Castle manuscript is a slightly edited copy of British Museum Add. 36529 and is therefore not to be used for copy-text for the poems it contains. I also assess the value of all the known texts for Surrey's poetry, including fourteen not known to Surrey's last editor.

In the chapter on the Canon I limit this edition to 54 poems plus the Virgilian translations after discussing all sources that ascribe poems to Surrey, or that ascribe poems to other authors which I believe to be his. I add no poems to the canon that F. M. Padelford did not include in his 1920 edition, but I do exclude four poems that he believed to be Surrey's.

The text of the poetry is critically corrected, but otherwise represents a diplomatic transcript of the copy-texts with no alterations of capitalization or punctuation. Complete variants are listed for all substantive texts, and the apparatus for the Biblical paraphrases includes an analysis of the many corrections made in the copy-text by the scribes and by sixteenth-century readers.

In appendices I give a descriptive and analytic bibliography of all substantive and non-substantive texts for Surrey's poetry, including all significant editions of his poetry printed to date.

Microfilm \$3.55; Xerox \$12.40. 275 pages.

HEAVEN VERSUS UTOPIA:  
A STUDY OF  
THE TRACTS FOR THE TIMES,  
1833-1841.

(L. C. Card No. Mic 60-4836)

Howard Wells Fulweiler, Ph.D.  
The University of North Carolina, 1960

Supervisor: J. O. Bailey

Although the Oxford Movement has been studied from many angles, no attempt has been made at a systematic examination of its principal documents, the Tracts for the Times. This dissertation attempts such an examination of the ninety tracts written at Oxford between 1833 and 1841 by Newman, the two Kebles, Froude, Pusey, and others.

One of the significant facts of our times is the dichotomy between the spiritual and the materialistic views of life, or between religious and secular ideals. This study examines the struggle between these opposing forces in early nineteenth-century England, as represented by the religious view of the tractarians as opposed to the utilitarian, practical, and materialistic view developed from Bacon, Locke, Descartes, Newton, and the Age of Reason, through Bentham and J. S. Mill. The complex of attitudes, goals, and philosophies surrounding the materialist ethos I have called, loosely, the Utopian Ideal. The reaction to materialism expressed by the Oxford Movement in the Tracts for the Times I have described as the Heavenly Ideal.

Amid the welter of secular solutions to the problems of the modern world, the Tracts attempted to define once more the traditional Christian solution, which the tract writers conceived to be the Catholic faith, as embodied in the Church of England. In the course of defining the Catholic faith and reviving it in the Church, the tractarians defined perceptively and clearly--if only to attack them--the main trends of their age. Thus they recognized early the rise in power of the secular state and issued a grave warning against it. They inaugurated a massive and early attack on Victorian middle-class values, opposing both what they considered to be the emotional and anti-intellectual errors of middle-class protestantism, and the materialism and cold rationalism of middle-class secular ideals as represented by figures like Bentham, Ricardo, or Macaulay. The great enemy, to the tractarians, was rationalism, both in its form of total dependence on human reason, as found in Bentham or J. S. Mill, and in its form of pragmatic relativism, as found in the broad churchmen. Throughout the Tracts, the writers defend the use of reason, but insist upon the supernatural Christian revelation as a basic premise.

The goal of the tractarians was to revive the primitive "apostolic" conception of Christianity and apply it uncompromisingly to Victorian England. For them the human predicament of living in two worlds, one spiritual and subjective, the other material and objective, could be solved only by a supernatural and authoritative religion. They felt that the rise of the materialistic spirit of the middle class--that spirit later described as "Mammonism" by Carlyle and as "Philistinism" by Arnold--and the general acceptance by all classes of rationalism and pragmatism could result only in the collapse of spiritual values. The rejection of divinely revealed authority, they feared,



would produce a vacuum to be filled with a new and ruthless authority--the secular state--a development which we in our own time have seen described imaginatively in Huxley's Brave New World and Orwell's Nineteen Eighty-Four. Thus, in the fourth decade of the nineteenth century, the fractarians opposed these three expressions of the Utopian Ideal: the materialism of the middle class, rationalism, and the authority of the secular state in religious matters. In place of the secular solutions of their age, they presented an older solution, in terms sharply vivid, frankly supernatural, and almost naively simple. They presented to a generation that had forgotten the vision of "one Catholic and Apostolic Church."

Microfilm \$3.40; Xerox \$11.95. 261 pages.

A STUDY OF COMIC ASPECTS IN  
THE PRINCIPAL CONTES PHILOSOPHIQUES  
OF VOLTAIRE

(L. C. Card No. Mic 60-5658)

David Lawrence Gobert, Ph.D.  
State University of Iowa, 1960

Chairman: Professor J. B. Rattermanis

Ira O. Wade's recent works on Voltaire's Micromégas and Candide have inspired us in method and object to study the comic in the main philosophical stories of Voltaire. Wade has demonstrated the existence of an organic unity in these works of Voltaire and the subject of this study was to determine to what degree comic aspects of the stories were integrated into this organic unity.

The body of this study is devoted to the analysis of the comic aspects of those stories in which we believe to exist the greatest organic unity: Candide, Micromégas, and Zadig.

We thought it necessary, however, not to limit ourselves to these three stories, but to treat also, in less detail however, others which are universally recognized as being inferior, for one reason or another, to the main ones. Our method was determined by our objective, which demanded that each conte be treated individually as an organic unity.

To facilitate organization we classified the stories into three groups, utilizing as the criterion for categorization the relation of the character to the action.

First we analyzed the comic aspects of the stories where the main character acted as Voltaire's "observer." The stories in this group are: La Princesse de Babylone, Histoire des Voyages de Scarmentado, Le Monde Comme Il Va, and Micromégas.

Secondly, we treated the stories in which the main characters were "victims," undergoing the action searching for happiness. These characters do not learn from the action but Voltaire awards them their goal. Stories in this group are: Cosi-Sancta, Memnon, on la Sagesse humaine, Le Blanc et le Noir, Le Crocheteur Borgne, Les Oreilles du Comte de Chesterfield et le Chapelain Goudman, Le Taureau Blanc, and Zadig.

The main characters in the third group of stories are more or less "blinded" and ultimately learn from the action. The stories in this group are: L'Ingénu, Histoire de Jenni, Les Lettres d'Amabed, Jeannot et Colin, and Candide.

Our desire to approach textual analyses of the contes impartially and without imposing any preconceived notions prevented us from elaborating a theory of comic. Nevertheless, we arrived at certain tentative working principles which helped to determine what could be considered as comic. Any forged relationship between words, ideas and acts, playfully offered, and which, from some point of view, can be evaluated as both "true" and "false" is comic. Several conditions must be fulfilled if comic effect is to be produced. The perpetrator of the misunderstanding, in this case, Voltaire, must constantly remind the audience that nothing really serious is going to happen in his contes, since comic cannot co-exist with the tragic.

Voltaire will achieve this ludicrous atmosphere by various means. For example, he will transfer the "known" into an unknown and many times unreal milieu, thus stylizing external reality so that it is recognizable and yet disguised. He gives his characters only a minimum of human qualities, depriving them of personal histories, or permitting them to detach themselves from their past. Instead of emotional reactions they will be supplied with a certain impermeability to the many blows with which he will shower them. The reader will imitate the character's own attitude and will also remain detached. Voltaire constantly violates the dichotomy between the planes of art and reality by intervening directly or indirectly during the progression of the action. The result is that the reader is intermittently reminded of the outrageous liberty of the author, and of his playfulness. Ultimately, he will magically resolve the conflict, and re-assemble his characters in a euphoristic "curtain-call" which reminds the reader that Voltaire has "taken him for a ride."

Microfilm \$2.80; Xerox \$9.90. 216 pages.

A STUDY OF THE PLAIN DEALER  
(1724-1725)

(L. C. Card No. Mic 60-4846)

Alice Louisa Love, Ph.D.  
The University of North Carolina, 1960

Supervisor: Richmond P. Bond

A study of the Plain Dealer brings to the fore a periodical which is one of the five major essay periodicals appearing between the Tatler, Spectator, and the Guardian of 1709-14 and Dr. Johnson's Rambler midway in the century. The Plain Dealer bears scrutiny because of the excellence and substantiality of its essays and also because of the names prominently associated with it: Aaron Hill, later and better known as an editor of the Prompter, William Bond, editor of the 1714 Spectator, and Richard Savage, poet-friend of Dr. Johnson and vagabond claimant to a title. Hill and Bond were the co-editors.

Making use of a popular caption of the time, the Plain Dealer was a folio half-sheet which appeared in London twice weekly from March 23, 1724, to May 7, 1725, a period of fourteen months. The limited use of advertisements (almost all were of new publications) and the low survival of copies indicate a low number of printed copies. The Plain Dealer twice appeared in book form, in 1730 and 1734.

Answers to the question of authorship and editorship in



regard to the Plain Dealer are largely conjectural. Hill was the better known of the two editors, and he may have given the effort financial backing as well as the prestige of his name. Certainly no final division into those numbers by Hill or those by Bond can be made. Both editors were experienced essayists, acquainted with the town, letters, and the theatre.

The content of the Plain Dealer is varied, but the area of principal concern is that of the reform of manners and morals. The attack on problems of conduct is both negative and positive. Popular superstitions, styles of dress, the infringement of public decorum, detraction, and family pride warrant editorial disapproval, as do more serious matters such as gambling, masquerades, low level of theatrical entertainment, and the vices of duelling and drinking to excess. Along with the negative pointing out of flaws is the positive and idealistic instilling of such constructive virtues as honesty or integrity (the best synonyms for the term plain-dealing), loyalty, magnanimity, moderation, and self-control. Mr. Plain Dealer obviously is much aware of the feminine sector of his reading public, and many remarks are directed to the somewhat narrowed field of their domestic concerns. The ideal personality projected for feminine readers possesses gracefulness, modesty, and dignity but in combination with candor and naturalness of manner; it is the editor's purpose to combat tendencies toward triviality and superficiality.

Second in prominence in the Plain Dealer is the area of literary criticism, a distinctive contribution being the discussion of the role of the critic and his relation to the artist as creator. Other characteristic viewpoints are criticism of the system of patronage, defense of John Dennis as a critic, praise of the "natural way" of writing and of the sublimity of Biblical poetry. Essays on the theatre are few, and specific plays and operas are alluded to occasionally but not discussed. There is no attempt at a "series" of papers on critical subjects such as appeared at intervals in the Spectator. A distinct feature of Mr. Plain Dealer's own efforts as critic is his introduction from time to time of the works of young and little known writers such as Savage, Joseph Mitchell, Mallet, and Thomson.

Other areas of less concern are philosophy, politics, and economics.

The Plain Dealer makes use of the forms and devices congenial to the essay periodical. Its use of the eidolon, club, and letter devices conforms to the established tradition. Mr. Plain Dealer is an eccentric bachelor but no stranger to the ways of the heart, and, finally, he falls a victim to the soft passion. He frequents two clubs, the members of which present considerable variety of characterization. These clubs and the interaction of fictional personalities add greatly to the animated quality of the essays. Dramatic possibilities are exploited in the Plain Dealer, and it is the Coquette of one of the clubs with whom the editor falls in love. Extensive use is made of the letter as a major and a minor device and of poetry. The essay remains the major element of design, but within this frame the minor forms are so manipulated as to give notable variety and diversity. Seldom is this an effect of fragmentariness, however. Characteristic of the Plain Dealer is the dramatic handling of character, situation, and dialogue. Fiction pieces and character writing are at a minimum.

Although subscribing to a pattern established by the

success of the Spectator, the Plain Dealer is a paper possessing individuality and charm. The intrinsic value of its essays on topics of temporary and permanent interest is considerable.

Microfilm \$2.85; Xerox \$9.90. 219 pages.

#### HAWTHORNE AND HOWELLS: THE MIDDLE WAY IN AMERICAN FICTION.

(L. C. Card No. Mic 60-4676)

James W. Mathews, Ph.D.  
The University of Tennessee, 1960

Major Professors: Nathalia Wright and  
Richard Beale Davis

The creative works of Nathaniel Hawthorne and William Dean Howells are illustrative of a trend toward the middle way in nineteenth-century American fiction. In seeking a kind of "golden mean" in philosophy of life and art, these two writers, like a large number of their contemporaries, attempted to reconcile many of the dichotomies in American life. From his young manhood onward Howells held a high admiration for Hawthorne, and much of the younger man's fiction reflects that of the older.

In their fiction both writers sought truth, which they felt lies between extremes. Although their literary approach to truth generally diverged into two distinct forms, the romance and the novel, they utilized in common three basic procedures: autobiography, symbolism, and the dramatic form. Despite his avowal of strict realism in technique, Howells, intermittently during his career, wrote psychological romances which could be termed Hawthornian.

Temperamentally Hawthorne and Howells were closely akin. As young men both led a rather solitary existence, which impressed upon them the malaise that might overtake one given to isolation from his fellow men. Thus their social consciousness became especially acute, and most of the problems in their fiction involve man's failure to come to satisfactory terms with his environment. The antithesis of isolation was expressed by Hawthorne as sympathy and by Howells as complicity; both terms embody a single concept of social unity. Although the two writers considered the individual responsible for his own ills, they felt that society at large deserves censure for its tyranny over the individual. They believed that social and governmental reform is necessary, but revolutionists (including fanatical philanthropists and advocates of Utopianism) have proved themselves incapable of carrying out responsible programs. The solution to social problems had to be a universal acceptance of the co-dependence of all men. Society must be unified through a general raising of individual sensibilities.

Each man or woman must respond to the balance that is taught by nature if he is to take his proper place in the democratic order, which to Hawthorne and Howells was also the moral order. The two writers noted that woman, in particular, is often prone to flout her natural place with relation to man and to assume a position incompatible with her own psychological make-up. The American woman at her best, however, is the highest example of virtuous individualism.



Nowhere is Hawthorne's and Howells' desire for balance more in evidence than in their consideration of man's spiritual life. Although materialism is the strongest foe of moral development, an excessive concern with the spiritual realm is a violation of nature. The material world is man's natural environment, and he must regard it as a reflection of the ideal. Anyone, whether religionist or artist, who becomes preoccupied with the metaphysical is neglecting his only approach to spirituality: earthly existence. Microfilm \$3.90; Xerox \$13.75. 301 pages.

THE METAPHYSICAL CONCEIT IN  
THE POETRY OF EDWARD TAYLOR  
(1644?-1729)

(L. C. Card No. Mic 60-4868)

Emma Louise Shepherd, Ph.D.  
The University of North Carolina, 1960

Supervisor: Raymond Adams

The purposes of this dissertation are to define the metaphysical conceit, to study Edward Taylor--an early American poet believed to have used the conceit--to show that he did use it, and to evaluate the way in which his conceits contribute to the unity of his poems.

Chapter I contains a survey of definitions of "metaphysical conceit" from earliest English criticism to the present. It finds that until the twentieth century the metaphysical conceit came to be considered a metaphoric device exhibiting the poet's abstract thought about non-material existence. Study of various definitions by modern students of English metaphysical poetry shows the problems in defining the conceit. The suggestions of T. S. Eliot and Helen White that the conceit is an elaborate extended metaphor are amended in the working definition of this dissertation: the conceit is a complex of metaphors in which a base metaphor is amplified by one or more metaphors using the same subject matter and having the same meaning.

Chapter II is a general study of Taylor. Born in England, Edward Taylor came to America in 1668, soon graduating from Harvard. He went to Westfield, Massachusetts, as its minister; he served there all of his life. He collected a sizable library and composed a 400-page quarto volume of poetry, one of his few extant works. The study reaffirms that Taylor's poems show orthodox non-Separatist Congregationalism and that Taylor's order that his writings not be published reflects his conviction late in life that they simply were not good enough, rather than his implication that they were unorthodox. The chapter reviews previous studies of Taylor, summarizing their considerable evidence that he shares characteristics with the English seventeenth-century metaphysicals.

Chapter III describes conceits in *Gods Determinations*, the longest single series of connected poems written by Taylor. It shows that every one of the thirty-six poems in the series has at least one conceit and that Taylor's method varies so that each poem primarily consists of either an extended conceit or unrelated conceits. The examination conclusively shows the predominance of the conceit in Taylor's metaphoric technique.

Chapter IV discusses the manner in which Taylor's conceits unify his poems. It quantitatively classifies the poems published in *The Poetical Works of Edward Taylor*, *The New England Quarterly*, *Publications of the Colonial Society of Massachusetts*, *Yale University Library Gazette*, and *American Literature*, demonstrating the two kinds of conceits in Taylor's poems, single, basic conceits extended through most of the metaphoric content and development of some poems or briefer, nonbasic ones. Basic conceits occur in one-third of Taylor's poems, which exhibit more metaphoric unity than his other poems because of the operation of the basic conceits. Although unity is also derived from other techniques and although basic conceits occasionally appear in poems which are chiefly ineffective or disunified, the study finds that in general Taylor's poems which are metaphorically unified by basic conceits are his most successful. Nonbasic conceits are demonstrated to be inconsistent in their manner and degree of unification.

After reviewing these conclusions, Chapter V presents general evaluations of his poetry and of his role as a metaphysical poet. It is suggested that basic conceits can be divided qualitatively into two kinds, either a chain of amplifications of the base metaphor growing logically and in sequence from it or a cluster of synonymous, interchangeable amplifications restating the base metaphor more specifically. Taylor's significance in metaphysical poetry is confirmed, primarily because the dissertation has specifically demonstrated his use of the conceit, a characteristic device of metaphysical poetry.

Microfilm \$2.85; Xerox \$9.90. 218 pages.

THE PILGRIMAGE OF  
THE RED CROSS KNIGHT

(L. C. Card No. Mic 60-5583)

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Adviser: Paul A. Olson

The purpose of this thesis is to present a systematic explanation of the allegory of that portion of *The Faerie Queene*, Book I, which deals with the adventures of the Red Cross Knight. The effect of previous Spenser scholarship has been to reduce the adventures of the Red Cross Knight to a series of unrelated episodes having vague and imprecise spiritual, moral, and theological overtones. Spenser's own intention, as revealed in the "Letter to Raleigh," was to construct a "continued allegory," and the criterion of "continued allegory," insists that each incident be significant both as a stage in the development of the action, and as a coherent, predictable part of the larger meaning of the work of art. If the journey of the Red Cross Knight from the Fairy Court of Gloriana to the Kingdom of Una is seen as an allegorization of the Christian's pilgrimage to salvation, then each episode during the course of the journey must be interpreted as a significant advancement in the Red Cross Knight's spiritual experience. Beginning with Spenser's own identification of the Red Cross Knight as a knight in Christian armor, like that specified in St. Paul, the exegesis of the events of the poem is

performed in light of Renaissance concepts of theology and philosophy, in so far as they are revealed by the iconographical and iconological details of the poem. These details, like the armor, had come by virtue of their use, to signify fairly specific theological concepts, and Spenser's use of other iconological material in the poem is interpreted against the background of meaning as contained in Renaissance commentaries on allegory, scriptural commentaries, and other contemporary literary works. The distinctive dress of Una and Duessa, for example, identifies them as the New Jerusalem (*visio pacis*) and Babylon (*confusio*) of Apocalyptic origin. The diamond shield of Arthur is shown to be a traditional symbol for God's grace. The Red Cross Knight's experiences in the House of Holinesse are related to the traditional steps in the mystical progress towards union with God, as formulated in the medieval and Renaissance manuals on mysticism. Prior to his being sanctified, the Red Cross Knight must overcome temptations of hypocrisy (Archimago), lust (House of Pride and Duessa), presumption and desperation (Orgoglio and Despaire). The findings of this investigation reveal that *The Faerie Queene*, Book I, has a consistent structure which is epic in nature, and that the literal details of the poem drawn from the traditions of romance and epic serve as the objective habitation of a highly organized theological pattern of sin and regeneration. Within this pattern, the Red Cross Knight emerges triumphant on both the temporal and spiritual levels.

Microfilm \$2.50; Xerox \$6.80. 141 pages.

#### LANGUAGE AND LITERATURE, CLASSICAL

##### FORESHADOWING AND SUSPENSE IN THE *PUNICA* OF SILIUS ITALICUS

(L. C. Card No. Mic 60-4827)

Mary Davis Beaty, Ph.D.  
The University of North Carolina, 1960

Supervisor: Robert J. Getty

The *Punica* is a poem which has been little read and much criticized. As a result, few efforts have been made in the past to examine the effectiveness of Silius' application of poetic techniques to his epic treatment of the history of the Second Punic War. The purpose of this work is to make a detailed examination of Silius' use of the well-known literary technique of foreshadowing, in order to determine whether it contributed substantially to the poetic worth of the *Punica*. Answers are also sought to such related questions as the amount and originality of the foreshadowing employed by Silius, the manner in which suspense is created and maintained, and Silius' similarity to Vergil in his use of this technique.

An initial study of the types and means of foreshadowing employed by Silius, such as statements by the poet, speeches by mortal and immortal characters, dreams, omens, etc., prefaces a consideration of the creation of suspense through foreshadowing in various segments of the poem. Since accounts of battles, which comprise almost one third of the

*Punica*, are naturally attended with excitement and suspense, this is an important area for a study of Silius' method of foreshadowing. Speeches by both mortal and immortal characters, provide another source of investigation as does the more subtle type of foreshadowing contained in comparisons and descriptive passages. There is also a discussion of the extent to which Silius forecasts events beyond the scope of the epic.

It is concluded that, although the characters in the *Punica* are kept in ignorance of the future to a remarkable degree, the reader of the poem is forewarned of almost every event which is to take place in the narrative. Such complete foreknowledge on the part of the reader contributes to the poetic effect of the poem by sustaining interest and anticipation, although it naturally eliminates any "suspense" in the modern sense of the word. Despite this lack of a suspense resulting from uncertainty of the future, the *Punica* contains a great deal of a type of suspense which is created by the reader's anticipation of a predicted event. Such suspense is frequently developed and maintained by the creation of an atmosphere of foreboding through the use of foreshadowing.

Although he followed Vergil and the established epic tradition to a certain extent, Silius shows some originality in his use of foreshadowing. The foreknowledge which he affords the reader is more extensive and definite than Vergil's while it is, at the same time, less subtle and artistic. It is impossible to deny that, to modern taste, the foreshadowing in the *Punica* seems excessive and somewhat artificial. Its importance in augmenting the dramatic effectiveness of the poem, however, far outweighs any criticism which may be directed against its use.

Microfilm \$2.70; Xerox \$9.45. 206 pages.

##### VIRGIL'S USE OF SYNONYMS

(L. C. Card No. Mic 60-4828)

Marvin Bryan Berry, Ph.D.  
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Supervisor: B. L. Ullman

The purpose of this study has been to ascertain the degree of intentional variation of vocabulary in the *Aeneid* through the use of synonyms. To facilitate the inquiry the *Aeneid* has been divided into supposed units of composition. These units, or episodes, have been determined by the sections of the poem which contain action, narration, speeches, and conversations.

The investigation has shown that, in the groups which contain four or more synonyms, a conscious effort has been made to refrain from the successive repetition of the same word and to avoid any pattern of repetition within a given unit. Patterns occur, however, in the examples which contain two or three synonyms within a unit consisting only of three or two words. These patterns, though, are probably due to the fact that a pattern could not be avoided in such small units. Except for these smaller groups the principle of a patternless pattern of arrangement is consistently seen throughout the poem.

Other observations have been made in Virgil's use of words:



1) the poet has effected an artistic technique of framing with individual words.

2) episodes are, at times connected by the insertion of a key word in one episode which is developed in the following episode.

3) in many instances a general word which begins a series of synonyms is clarified and defined by a more specific word which follows, or else a specific word will precede and clarify a general word which follows.

Microfilm \$3.70; Xerox \$13.05. 288 pages.

#### THE VERONA FLORILEGIUM OF 1329

(L. C. Card No. Mic 60-4839)

Charles J. Gross, Jr., Ph.D.

The University of North Carolina, 1960

Supervisor: B. L. Ullman

The Verona florilegium of 1329 is a compilation of quotations from mediaeval and classical Latin authors. These were sententious expressions probably used for didactic purposes. The text is often corrupt, and therefore the worth of the manuscript lies in its historical, not palaeographical, importance. However, the readings from some texts such as that of Publilius Syrus are palaeographically interesting because of the fact that this florilegium is one of the basic sources for our knowledge of these texts.

The florilegium contains such a wide variety of writings from both mediaeval and classical authors that it would seem to establish for Verona in the fourteenth century a tremendous interest in and knowledge of Latin studies. Anthologies of this type were well known in the Middle Ages and served to perpetuate the classics.

The purpose of this dissertation has been to publish for the first time the text of the Verona florilegium, to locate the passages wherever possible, and to point out textual problems in the manuscript itself. In the Introduction I have summarized scholarly studies of this work and pointed out the main problems concerning the florilegium. The bibliography may be used as an index to the critical texts used in comparing the readings of the Verona florilegium with those of the established textual tradition.

Among the authors for whose text or textual history this florilegium is important are Catullus, Tibullus, Cicero's letters to Atticus, Publilius Syrus, Corippus, and Pliny's letters. Important too are quotations from Greek philosophers, taken from a mediaeval Latin source now lost or unidentified.

Microfilm \$3.95; Xerox \$13.95. 307 pages.

#### LANGUAGE AND LITERATURE, LINGUISTICS

##### THE STUDY OF LANGUAGE IN ENGLAND 1780-1860

(L. C. Card No. Mic 60-5153)

Hans C. Aarsleff, Ph.D.

University of Minnesota, 1960

In 1786 John Horne Tooke brought out the first volume of his *Diversions of Purley* at London, and in the same year Sir William Jones delivered his discourse "On the Hindus" to the Asiatic Society at Calcutta. Both were profoundly influential: Tooke's work in England, Jones's chiefly on the Continent, where, through Rask in Denmark and chiefly Schlegel and Bopp in Germany, it gave the impulse (though not all the motives) to the formation of the historical, comparative study of language, which since has generally been called philology or more precisely the "new philology." By 1860 the Philological Society of London had undertaken the publication of what is now the *Oxford English Dictionary*. The purpose of this dissertation is not merely, nor even primarily, to record the chronological sequence of the relevant events, but to seek out the reasons that will explain the events themselves and their sequence. Hence, the object is to give a coherent account of the intellectual development that links the philosophically-oriented preoccupations of the 1780's with the philological concerns of the 1850's. The central thesis is that 19th-c. philology has its historical origin in the philosophical discussions of language that began in the 17th century, and not--as has generally, though never clearly, been assumed--in the earlier work that superficially has the closest resemblance to philology--in 17th-c. Anglo-Saxon scholarship for instance. In the 18th century these discussions came to center on the two problems of universal grammar and the origin of language, the former the legacy of Rationalism and the latter of Locke's philosophy; together they formed the comparative, etymological method. This thesis requires the substitution of the term "study of language" for "philology" to remove the major source of confusion.

Chapter I considers the background from ca. 1650: The Royal Society's program for plain language, Wilkins' philosophical language, Locke's *Essay* (especially Book III) and the Port-Royal grammars with the subsequent 18th-c. discussions in Berkeley and Hume, in James Harris, Priestly, Adam Smith, and Monboddo. Chapter II gives a critical exposition of Tooke's philology, which asserted that "what are called the operations [of the mind] are merely the operations of language." Hence, in the 18th-c. fashion, the study of language is the study of mind; Tooke's purpose was to do away with "all the different systems of metaphysical (i.e. verbal) imposture," and his starting point was Locke's *Essay*, which Tooke said was "merely a grammatical essay, or a treatise on words, or on language." Chapter III considers Tooke's influence and reputation to 1830. Aided by the powerful analogy of contemporary science (chemistry), Tooke's materialist philology was accepted by the Utilitarians and by James Mill's *Analysis* given a very prominent place in their psychology. Tooke's "etymological metaphysics" was most cogently and effectively criticized by Dugald Stewart, largely but not entirely in the tradition of Reid's common sense philosophy.



Stewart placed emphasis on usage as one of the chief factors behind meaning. Chapter IV takes up Jones, his work in England and India, his reputation in Germany, and the followers Schlegel and Bopp, with the background in Leibniz, J. D. Michaelis, and Herder. Chapter V surveys the new philology in England to 1842, introduced by B. Thorpe, who studied under Rask, and J. M. Kemble, who became Grimm's pupil; their chief contribution was Anglo-Saxon text publication, spurred by N. F. S. Grundtvig's prospectus (issued in 1830) of texts that should first be printed. Chapter VI accounts for the formation of the Philological Society; its membership; its close link to Trinity College, Cambridge; its work; and the plan for the dictionary. Chiefly responsible for the Dictionary was Archbishop Trench, who wished, as a move against the "false prophets," to anchor words in their usage through the centuries. The lexicography was derived from Franz Passow and from Liddell and Scott's *Greek-English Lexicon*, not as generally believed from Richardson Dictionary. Thus this dissertation deals with a highly significant part of English thought, at the same time as it provides a new orientation in the history of European philology. Microfilm \$7.60; Xerox \$27.00. 598 pages.

#### A RECONSTRUCTION OF PROTO-COLLOQUIAL ARABIC

(L. C. Card No. Mic 60-6494)

William George Cowan, Ph.D.  
Cornell University, 1960

Previous statements on the historical phonology of the colloquial dialects of Arabic have traced developments either from Classical Arabic, or from a form of Classical characterized by the lack of case and mood inflections. This thesis attempts to reconstruct the phonology of the language ancestral to the colloquial dialects by using only the evidence of the dialects themselves. The reconstruction is based on the following twelve dialects: Moroccan, Spanish Arabic, Maltese, Djidjelli (rural Algeria), Algerian Jewish, Tunisian, Central Asian, Aleppo, Cairene, Jewish Yemenite, Moslem Yemenite, and Bagdadi.

As a first step, a Proto-Western Arabic is reconstructed from the first six of these dialects. The phonemes of Proto-Western are: consonants \*/t t̤ k q b d f θ s ʃ x h h ʕ ʔ z ʒ ʔ 9 m n l r w y/; vowels and vocalic nuclei \*/i a u i: a: u: o: ay aw/; a phoneme of stress. The developments are traced from Proto-Western to each of the dialects in terms of consonants, stress, and vowels. Proto-Colloquial Arabic is then reconstructed from Proto-Western and the remaining six dialects. The phonemes of Proto-Colloquial are: consonants \*/t t̤ k q b d f θ s ʃ x h h ʕ ʔ z ʒ ʔ 9 m n l r w y/; vowels and vocalic nuclei \*/i a u ə i: a: u: o: ay aw əw/. The developments are traced from Proto-Colloquial to each of the dialects in terms of consonants, stress, and vowels.

The 306 reconstructed forms used as evidence, and the cognate sets upon which they are based, are presented in list form after the sections on Proto-Western and Proto-Colloquial Arabic. An appendix gives the details of the interpretation of the recorded material on Spanish Arabic.

Microfilm \$2.50; Xerox \$6.80. 143 pages.

#### THE STRUCTURAL DESCRIPTION OF AN ALCAMESE SICILIAN DIALECT IN AMERICA

(L. C. Card No. Mic 60-4878)

Robert Joseph Di Pietro, Ph.D.  
Cornell University, 1960

The dialect described is the one spoken by Alcamese Sicilians and their children living in the Southern Tier communities of Endicott, Johnson City and Binghamton, New York State. The study is synchronic, describing the language as it was spoken at the time that the corpus was collected (1959-60). There are five main sections:

(1) phonology, (2) morphophonemics, (3) morphology, (4) syntax and (5) intonation. Three appendices are included: (1) a popular story in morphophonemic notation, (2) an alphabetical list of all the stems mentioned in the thesis with their morphophonemic formulae and glosses and (3) an alphabetical English-Sicilian word list.

**Phonology.** Phoneme classes are the following: five vowels /i e a o u/, two semivowels /j w/ and nineteen consonants /p b t d k g c ʧ ʤ f v s ʃ m n ñ ŋ r l/. There is one phonemic contrast of stress, co-occurrent with vowels. There are three pitch levels /<sup>1</sup> <sup>2</sup> <sup>3</sup>/ and three terminal contours / | ↓ ↑ /. All consonants occur in geminated clusters. Syllables have seven arrangements of consonants (C) and vowels (V): V, CV, CCV, CCCV, VC, CVC, CCVC. The only consonant occurring after V is /r/.

**Morphophonemics.** There are eight phonemically conditioned alternations and six morphemically conditioned. The following morphophonemic symbols are established and employed in the remainder of the thesis: vowels: i e E a O o u, semivowels: j w, consonants: p b t d k K g f v V s ʃ Š š c ʧ ʤ m n ñ ŋ l L r x, stress: ˘.

**Morphology.** This section is subdivided into inflection and derivation.

(a) Inflection. Fifteen stem-types are established on the basis of morphological and syntactical privileges of occurrence: (1) adjectives, (2) nouns, (3) numerals, (4) verbs, (5) articles, (6) demonstratives, (7) possessives, (8) prepositions, (9) pronouns, (10) coordinators, (11) subordinators, (12) prophrases, (13) proclauses, (14) particles, (15) verbal auxiliaries. There is also an overriding division of stems into functors and contentives. Stem types 1 through 4 are contentives and 5-15 are functors. There are five grammatical categories: (1) gender (masculine, feminine), (2) number (singular, plural), (3) person (first, second, third singular and plural), (4) predication (finite, non-finite), (5) tense (preterit, imperfect, non-past, unreal).

(b) Derivation. Stems are built by three processes: affixation, compounding and the reassigning of stems in the same or to different form classes. Stems, roots and affixes exhibit several kinds of alternation in shape. Each alternant is listed and defined in terms of the environment in which it occurs.

**Syntax.** A preliminary section is devoted to syntactical linkage. There are three main types: (1) concord, (2) cross-reference, (3) government. Discussion of constructions begins with phrase structure (including both the centered and uncentered types). The verbal core is defined as a verb or verb phrase with procomplement pronouns. There are two sequence types for procomplement pronouns:



(1) before the verb or verb phrase when it contains a finite, non-imperative form, (2) after the verb when it is an imperative or non-finite form. There is no basis to justify a separate imperative on the morphological level. Syntactically it becomes evident only in the presence of pro-complement pronouns. Clauses are those constructions containing a verb or verb phrase and either (a) predication or (b) a subject constituent. The final section of syntax treats the types of constructions which occur as sentence constituents, i.e., as the remainder in complete utterances.

Intonation. Morphemically significant arrangements of pitch levels and terminal contours constitute the intonational contour. Only the most characteristic contours are discussed. The last section is a list of examples illustrating contours whose meaning is not easily stated in descriptive terms.

Microfilm \$2.50; Xerox \$6.80. 145 pages.

**A RECONSTRUCTION OF  
PROTO-RHAETO-ROMANCE AND  
ITS IMPLICATIONS FOR THE HISTORY  
OF FRENCH**

(L. C. Card No. Mic 60-6508)

Clifford Shattuck Leonard, Jr., Ph.D.  
Cornell University, 1960

This thesis attempts to clarify the relationship of the Rhaeto-Romance dialects to the standard Romance languages. Phonological criteria characteristic of Proto-Rhaeto-Romance (PRR) are established by the comparative method from a representative corpus of words in ten modern Swiss and (politically) Italian dialects: those of Gradisca, Colloredo di Montealbano, and Pesariis in Friuli; of Moena, Livinallongo, the Val Gardena, and San Vigilio di Marebbe in Alto Adige; and of Scuol, Cunter, and Trun in the canton of Grisons.

The work is handled in three stages, Proto-Friulian, Proto-Dolomite, and Proto-Grisons, which are then compared with each other to arrive at reconstructed Proto-Rhaeto-Romance. PRR is found to be characterized by (1) phonemic vowel length (in Proto-Italo-Western [PitW] open syllables) and (2) the umlaut of PitW /*ǝ*/ before posttonic /i u/ and certain posttonic clusters. Examples of (2):

PitW	PRR
lentjǝlu, pl. lentjǝlos 'sheet'	lncǝ:l, pl. lncǝ:ls
grǝssu, fem. grǝssa 'fat'	grǝs, fem. grǝsa
fǝllja 'leaf'	fǝlja
ǝklos (cluster /kl/) 'eyes'	ǝjls

In view of these innovations, it is reasonable to connect PRR with an unattested stage of pre-Old French in which (1) phonemically long vowels diphthongized or otherwise shifted, and (2) the /*ǝ*/-/*ǝ*/ morphophonemic alternation resulting from the umlaut was leveled (by specialization of /*ǝ*/ in short nuclei and of /*ǝ*/ in long nuclei) but structural evidence of its former existence is to be found in (a) the phonetic fronting of the phoneme /a/, (b) the pala-

talization of /k g/ caused by the fronting of /a/, and (c) the fronting of PitW /u/ to /y/.

Thus it is argued that French and Rhaeto-Romance are descended from a Northern Romance stock historically distinct from the Western stock that gave rise to Provençal and the Iberian languages, for in none of the latter languages can evidence of phonemic vowel length and the umlaut of /*ǝ*/ be found.

Microfilm \$3.25; Xerox \$11.25. 249 pages.

**A DICTIONARY OF THE PERSONAL NAMES  
IN THE EDDIC POEMS  
(ELDER EDDA AND EDDICA MINORA)**

(L. C. Card No. Mic 60-4856)

Mary Gray Porter, Ph.D.  
The University of North Carolina, 1960

Supervisor: George S. Lane

This dissertation is an attempt to make available, in a single reference work, whatever information can be assembled concerning the identity of the persons named in the Eddic poems.

The names included in the dissertation are taken from the older anonymous poems which are known collectively as the *Elder Edda* (*Saemundar Edda*) and from the fragments scattered throughout the *Snorra Edda* and the *Fornaldarsögur norðrlanda* which have been collected and published under the title *Eddica Minora*.

The main purpose of this dissertation is to identify, as precisely and completely as possible, the persons named in the Eddic poems, and to do this on the basis of the information contained in the Eddic poems themselves, in the *Snorra Edda*, and in the *Fornaldarsögur norðrlanda*.

For the purposes of this study, I have regarded as persons the few historical personages whose names appear in the Eddic poems, figures of the legendary past, and mythological beings who appear to have been visualized as having more or less human form. Names other than names of persons have been included only when a personal name also denotes something other than a person and when one editor or another has construed as a personal name a word which is more probably a common noun.

After the name itself, the person designated by the name is identified as precisely as possible, by his family connection and by his exploits, where these are known. Sometimes the person is completely unidentifiable; or it may be possible to determine only that the name is that of a dwarf, a giant, or one of the minor deities.

The text of Neckel's third edition (Heidelberg, 1936) is the basis for the form of the names and for the numbering of the strophes. Other editions are referred to only if they differ from Neckel. Each entry includes, in addition to the identification of the person, the following information: the places in the Eddic poems where the name occurs and the variant forms of the name, if the manuscripts or other editors differ from Neckel and if the variants are significant.

No attempt has been made in this dissertation to give a definitive etymology of the names or to trace the

development of any given personality, for example, from a coalescence of several originally distinct characters or from the development of an originally single figure into two or more persons.

Microfilm \$3.25; Xerox \$11.50. 251 pages.

## LANGUAGE AND LITERATURE, MODERN

### RHETORIC AND LOGIC IN MILTON'S ENGLISH POEMS

(L. C. Card No. Mic 60-4832)

Dan Stead Collins, Ph.D.  
The University of North Carolina, 1960

Supervisor: Ernest William Talbert

This study describes Milton's interest in disputation and oratory and traces the effect of this interest upon his poetry. The importance of disputation in seventeenth century education necessitated Milton's frequent participation in formal debates at Cambridge--an experience which, despite some annoyances, left him favorably impressed with the significance and excitement of a defensive act which relied wholly upon the force of reason.

Although conclusions regarding Milton's performance in debate must be drawn from general knowledge of the conventions of disputation, more specific evidence supports our understanding of Milton as an orator. The prolusions provide examples of Milton's brief orations, and his epistle to Hartlib contains important judgments concerning rhetoric. The clear inference derived from these sources and from the later prose is that for Milton the great standard in matters of rhetorical theory and practice was Cicero. Especially attractive to the young Puritan was Cicero's selection of wisdom and virtue as the orator's basic resource rather than stylistic proficiency or sharpness of wit.

Most typical of Milton's early oratory is his disputer's insistence upon establishing a difficult or obscure point, particularly the demonstration of a harmony where only discord had been thought to exist. In general, the early works are examples of epideictic oratory, and the excellences that are asserted in them serve to celebrate God's benign providence. A significant characteristic of the prolusions is their frequent division into three parts--the result of Milton's having carefully observed the Ciceronian requirement that each orator instruct, please, and move his audience.

Analysis of the themes and structure of Milton's early poems reveals that their author has applied many of his rhetorical themes and practices to his poetry. Like the prolusions, the early poems celebrate God's providence by demonstrating the transcendent harmony in nature. A tendency toward three-part division can be noted in early poems, but a more obvious connection of poetry and oratory is exemplified by the *Vacation Exercise*, a poem which forms the peroration of the *Sixth Prolusion*.

The influence of disputation and oratory became more pronounced in poems written after the close of Milton's

Cambridge career, for the temptation theme, to which the poet turned at this time, encouraged rhetorical development. *Comus*, *Lycidas*, the epics and *Samson Agonistes* feature a central character who might appropriately be termed "the Respondent," since his most significant action consists of defending a challenging proposal against the deceptive arguments of "adversaries."

Although these great poems represent several literary types they are alike in containing a "temptation pattern" in which an episode of self-temptation leads to the central debate. This debate contains the challenge to virtue represented by the three traditional types of fraud: suggestions of distrust, encouragement of vainglorious aspirations, and incitement to idolatrous actions. To Milton the challenge is a rhetorical one, the distrust consisting of a false instructing, the vainglory of an improper pleasing, and the idolatry of a detrimental moving of the audience. The outcome of this rhetorical challenge is the climactic action, leading to the denouement, which, in Milton, is characteristically a praise of God's providence.

Microfilm \$3.15; Xerox \$11.05. 241 pages.

### PSYCHOLOGISM IN RUSSIAN LITERARY SCHOLARSHIP: ALEXANDER POTEBNIA AND HIS SCHOOL

(L. C. Card No. Mic 60-5088)

John Fizer, Ph.D.  
Columbia University, 1960

This dissertation focuses on the literary theory of Potebnia and his followers, or Potebnianism. In order to treat this theory adequately, it is indispensable to discuss it within the framework of psychologism, a trend in Western-European thought during the second half of nineteenth century with which Potebnianism has been linked, sometimes justly, sometimes unjustly.

The exposition and evaluation of Potebnianism in this dissertation are divided into two parts. The first part expounds the literary theory of Potebnianism, the second the applied criticism of Potebnianists. However, it is the former which constitutes the main body of the work.

As a literary theory, Potebnianism is derivative. It borrows considerably from the esthetical and linguistic views of the German scholars Wilhelm Humboldt, Heymann Steinthal, Moritz Lazarus and Herman Lotze. Conceiving of the literary art primarily as a projection of the creative mind, Potebnianism chooses to analyse such problems as artistic creation, artistic perception, poetic imagery, the function of literature, and differences in function between literature and science.

Potebnianism considers imagery to be the central problem of literary theory and criticism. It contrasts images with facts, statements, assertions, ideas; in brief, it thinks of images as observations with potentially multiple meanings. This multiplicity of meanings in poetic imagery is called forth by the subjective world of each individual perceiver. Yet, according to Potebnianism, people belonging to one ethnic group possess a common national psyche (*Volksgeist*) which facilitates the similarity and sometimes even the identity of individual perceptions. This national psyche expresses itself best in language.



Language, therefore, is the ideal reflection of ethnic unity and ethnic spirit.

Poetic imagery is created by means of tropes or figures, such as synecdoche, metonymy, metaphor, allegory and hyperbole. These tropes are not stylistic devices or linguistic ornamentation in the literary work; they are essential vehicles of thought. Since poetic images suggest rather than assert concrete meaning, one cannot speak of determinate ideas in a poetic work, even though the creator might have had some particular or concrete ideas in mind when he was creating his imagery.

Potebnianism reduces the functions of a literary work to two: cognition and catharsis. In making this reduction it adheres to the utilitarian conception of literature. By the cognitive function of literature Potebnianism understands primarily an act of self-cognition. In projecting themselves creatively into an object of perception, both artist and reader see themselves, become aware of the elements composing their individual psyches, and relate themselves to external events, and phenomena. Awareness of these external things brings about a soothing of emotional disturbance, a spiritual tranquility. For this reason literature has therapeutic significance. It is precisely in its therapeutic value that the second function of literature, namely catharsis, consists.

In discussing these problems the followers of Potebnia do not always voice identical opinions. Often their interpretation and elaboration result in assertions which contradict those of Potebnia.

Some of the Potebnia's followers published critical works on Russian writers. Of these Dimitrii N. Ovsianiko-Kulikovskii, the most noteworthy, undertook to scrutinize psychologically such writers as Pushkin, Gogol, Turgenev, Tolstoy and Chekhov. In these studies, however, Ovsianiko-Kulikovskii seldom observed the theoretical position of Potebnianism. This is also true of Arkadii G. Gornfeld's study of Tiutchev and Pushkin and of Timofei I. Rainov's study of Goncharov's *Precipice*. Potebnia himself wrote no critical study.

In the concluding chapter, the dissertation treats the affinity between Potebnianism and Russian symbolism, formalism and imaginism. Some of the representatives of these schools attempted to find in Potebnianism both the historical antecedent of their own position and a source of inspiration. In so doing, as the dissertation makes clear, they mistook the true nature of Potebnianism.

Microfilm \$3.40; Xerox \$11.95. 261 pages.

THE NEWGATE NOVEL, 1830-1847:  
BULWER, AINSWORTH, DICKENS,  
AND THACKERAY.

(L. C. Card No. Mic 60-5093)

Joseph Keith Hollingsworth, Ph.D.  
Columbia University, 1960

The Newgate theme was not new, but special circumstances brought it to prominence between 1820 and 1850. In the eighteen-thirties and forties, "Newgate novel" was a derogatory term for works of fiction which presented criminal characters and scenes of low life or which were thought to induce improper sympathy for criminals.

Agitation against the antiquated criminal law and especially against the large number of capital statutes became formidable in the eighteen-twenties. Reforms of that decade were both administrative and statutory, but they hardly reduced the real incidence of capital punishment. In 1830, the operative statutes imposed almost the same penalties as in the eighteenth century, but a decade of significant change followed; by 1841, the law, though still severe, was essentially modern. There was no further reduction of capital penalties for twenty years.

The Newgate novels sometimes paralleled or followed this change in the law but did little to bring it about. In the eighteen-twenties, notorious criminal cases were dramatized and used in fiction, but the first novel to attack the criminal law was Bulwer's *Paul Clifford* (1830). Reform being in progress, later novels about criminals either became simple entertainment or explored the psychological and social context of criminal acts. The Newgate novelists can hardly be called a school, but the chief of them, Bulwer, Ainsworth, and Dickens, were acquainted with each other, and their works were bracketed together by hostile critics.

Since *Paul Clifford* included political satire of a Radical cast and also a personal attack upon William Maginn, editor of *Fraser's Magazine*, the Newgate novel was from the start involved in controversies which had little or nothing to do with the subject of crime. Bulwer's next novel, *Eugene Aram* (1832), a romance based on an eighteenth-century case, was for many years used by the opposition to show that the author had condoned murder. On the other hand, Ainsworth's *Rookwood* (1834), in which the highwayman Turpin appeared, was little censured.

Dickens' *Oliver Twist* (1837-8) showed London criminals in a modern setting. Popular as the book was, some persons objected to its low subject matter. Ainsworth's *Jack Sheppard* (1839-40) romanticized an eighteenth-century prison-breaker; its popularity on the stage roused the fears of sober observers. The most energetic critic of the Newgate novelists at this time was Thackeray, who ridiculed Bulwer between 1837 and 1847, criticized *Oliver Twist* tactfully but forcefully, and wrote a short novel, *Catherine* (1839-40), to show how criminals might be honestly presented. *Catherine* was a failure, but the hostility aroused by the *Sheppard* mania caused Ainsworth to avoid writing about criminals thereafter. Dickens continued to use the material of crime, but in such a fashion as to prevent opposition.

After *Night and Morning* (1841), only mildly censured, Bulwer returned to a criminal theme when he used the Wainwright case as the basis for *Lucretia* (1846). Thunderous newspaper criticism, attributable partly to prejudice against the author and partly to fear of the cheap serials then current, caused Bulwer to decide against writing about criminals in future. Thackeray's ridicule, as Bulwer's unpublished letters show, very nearly caused Bulwer to call him out. Thackeray, successful with *Vanity Fair* and sharply affected by Forster's and Dickens' criticism of his Bulwer parody, "George de Barnwell," ceased to criticize the Newgate writers.

In a transitional and experimental period, when criticism of a high order would have been valuable, the long debate over proper matter and manner in fiction was thus confused by irrelevant controversy from beginning to end. No one questioned, however, the principle of the writer's social responsibility. Microfilm \$4.40; Xerox \$15.55. 342 pages.



THE AMBASSADORS:  
A MODERN ALLEGORY.

(L. C. Card No. Mic 60-5665)

Floyd Ross Horowitz, Ph.D.  
State University of Iowa, 1960

Chairman: Professor John McGalliard

The critical purpose of this dissertation on Henry James's *The Ambassadors* is to explicate the basic design of what appears to be--apart from the story level--a three levelled allegory. Because previous critical consideration of James's fiction has set no precedent for such an analysis, the design which this dissertation proposes will necessarily put a burden upon the reader; even upon the reader who is well acquainted with the work: it will demand that he keep track of charts, images, key symbols, and even puns. The analysis based on such devices is intended to account for the complete internal structure of the work--point of view, images, symbols, chapter sequence, characterization, and plot formation. The interrelationships of these factors serve to blueprint the levels of the allegory.

The organization of this dissertation is thereupon constructed as a related series of logical modes, mainly concerned with tracing the images and then the symbols. Chapters One to Three are concerned with the ordering devices of the allegory. Chapters Four to Seven are concerned with tracing out the main image patterns. Chapter Eight is concerned with a Platonic symbolic value system. Chapters Nine to Eleven are concerned with the Christian symbols of the allegory.

Although a certain amount of interpretation is involved in the analysis of such a complex, the intention here has been to describe a full set of terms which will not sway with the wind of individual interpretation. At the same time, these terms may be used as the basis for all the modern modes of interpretation.

Microfilm \$4.50; Xerox \$16.00. 352 pages.

TURGENEV AND THE FRENCH

(L. C. Card No. Mic 60-5096)

Richard Georges Kappler, Ph.D.  
Columbia University, 1960

The study *Turgenev and the French* is essentially a synthesis of the subject of Turgenev and France in every aspect other than political. Turgenev lived a large part of his life abroad and chiefly in France owing to his connection with the Viardot family. It was largely through the Viardots that he made contacts with the noted French figures of his day.

It is in Turgenev's correspondence with Madame Viardot and others that he reveals his reactions to the older generation of French writers. Except for Sand and Mérimée he was generally unfavorable to the pre-naturalists and preferred historical writers such as Michelet and Louis Blanc to novelists and poets. Except for Mérimée Turgenev had closer personal contacts with the naturalist writers than he had with the French writers of the older generation. He found himself more in tune with their artistic ideas

though he disliked some of the literary excesses of the naturalists and criticized rather severely some of their works in private conversation and in his correspondence. Some of Turgenev's criticisms reached Alphonse Daudet after the Russian's death and led to the "Daudet-Turgenev Incident" which provoked a storm in both France and Russia.

Turgenev was closest of all to Gustave Flaubert. The correspondence of the two writers is touching proof of their mutual friendship and since fortunately most of their letters have been published, the story of their relations can be reconstructed. Having met in 1863 their acquaintance ripened into warm intimacy when Turgenev moved to Paris from Baden after the Franco-Prussian War. They were drawn together by common literary ideals and by a similar emotional makeup. The friendship was particularly significant for Flaubert and Theodor Reik has even claimed that it had homosexual coloring. There was not much question of mutual literary influence, though Flaubert did seek Turgenev's advice on literary matters. Turgenev was instrumental in obtaining a post as librarian for Flaubert when he was faced with financial ruin and after Flaubert's death made an unsuccessful attempt to raise money in Russia to help pay for a monument to Flaubert at Rouen.

Turgenev's cultural interests were wide and his literary tastes were truly cosmopolitan. He was an expert linguist having a knowledge of French, German, English, Spanish and Italian. His personal contacts with publishers, translators and critics in several countries enabled Turgenev to serve as a kind of international literary agent for both his fellow Russians and his French colleagues. He acted not only as an agent but also as a translator himself of various works into both Russian and French. By himself or in collaboration with Louis Viardot, Turgenev translated Pushkin, Lermontov and Gogol into French. The Russian author exerted every influence he had to launch Tolstoy in France. Other Russian authors whom he attempted to introduce into France include Dostoevsky, Sergei Aksakov, Pisemsky, Ostrovsky, Vsevolod Garshin and Alexei Tolstoy.

Into Russian Turgenev translated Perrault's *Contes de ma Mère l'Oie* and Flaubert's *Légende de Saint Julien l'Hospitalier* and *Hérodias*. It was Turgenev who introduced Zola into Russia and some of Zola's works appeared in Russia in the *Vestnik Evropy* before their publication in the original French in Paris. Turgenev also did much to make the works of Maxime Du Camp, Daudet, Edmond de Goncourt and Maupassant known in Russia.

Turgenev himself enjoyed wide popularity in France though his reputation was eclipsed by Dostoevsky and Tolstoy after his death. All of Turgenev's works appeared in French translation soon after their Russian publication. He was admired by such figures as Mérimée, Taine, George Sand, Lamartine, Guizot and Maupassant most of whom wrote articles on the Russian author. Ernest Renan pronounced a funeral oration at Turgenev's death in 1883.

Microfilm \$2.95; Xerox \$10.15. 225 pages.



DRAMA ILLUSTRATING DOGMA:  
A STUDY OF THE YORK CYCLE.

(L. C. Card No. Mic 60-4845)

Stephen Joseph Laut, S.J., Ph.D.  
The University of North Carolina, 1960

Supervisor: E. W. Talbert

The purpose of this dissertation is to examine the York Plays in order to study the relationship of doctrine to dramatic technique. In the plays is found a combination of the sermo humilis or humble style and a sermo sublimis or lofty style. According to the medieval rhetoricians the sermo humilis employed only the colores faciles, such as repetition, contrast, and characteristic language. Part of the sermo humilis too is the peculiar York formula for the beginnings and endings of the plays. Each play begins with the principal actor of the particular pageant summarizing the preceding events. Each play closes with a stylized stage clearance which usually terminates in a dance. The only exceptions to this rubric are the plays of the Nativity and of the Crucifixion which end in tableaux.

In the sermo sublimis there is developed a doctrine involving three channels of inspiration: Christian, Franciscan, and Scotistic. The general Christian doctrine contained in the plays can be found in the Lambeth Constitutions of Archbishop Peckham, promulgated in the year 1281. These are the articles of the Creed, the Ten Commandments, the Seven Sacraments, the Seven Deadly Sins, the Works of Mercy, and the Two Great Commandments of the Law.

The specifically Franciscan doctrine embraces the Friars' insistence on the primacy of the will over the intellect. Thus throughout the plays love and obedience are the two most important virtues. The Augustinian-Bonaventuran notions on the illumination of the intellect are omnipresent and Bonaventure's peculiar notions on mysticism appear in a key play in the cycle. The Kingship and Humanity of Christ are highlighted in the cycle and the Passion and Nativity are the two focal points of the plays, precisely as they are in Franciscan theology. The teachings of the Franciscan "light-metaphysicians" is apparent in the cycle as are the Franciscan devotions of the Seven Last Words, the Seven Sorrows of Mary, the Joys of Mary, and the Stations of the Cross.

Scotistic influence is apparent in the plays in the doctrines of Creation by the Son, the absolute voluntareity of God, the fall of Lucifer from "quasi-luxuria," not pride, and the Immaculate Conception. The most characteristically Scotistic doctrines relate to the Incarnation and are clearly seen in the York Plays. These are that the Incarnation was determined by the Father prior to and independent of Adam's sin, and that the purpose of the Incarnation was primarily to establish Christ as Head of the Mystical Body.

In the course of the examination of these plays, several hitherto undetected sources are discovered. Among these are The South English Legendary, the Historia Scholastica, the Horae Eboracenses, The Privite of the Passion, The Meditations on the Supper of the Lord, and the Transitus Mariae. Other plays are derived from poems and lessons of the Breviary.

The dissertation concludes that the Christian, Franciscan, and Scotistic doctrine of the sermo sublimis have

been skillfully blended and so expressed in a sermo humilis that all, even the common people, would be able to recognize and grasp them. The plays thus fulfill with great success their double function of teaching and entertaining. Microfilm \$3.35; Xerox \$11.70. 259 pages.

EIGHT STORIES

(L. C. Card No. Mic 60-4391)

Charles L. Miller, Ph.D.  
State University of Iowa, 1960

Chairman: Assistant Professor Donald R. Justice

This dissertation is made up of eight short stories. "The Night Before Christmas" concerns an old man acting as a street corner Santa Claus on Christmas Eve. His reactions to his job and the kind of life he leads are examined. "And Damned If She Didn't" deals with a youth who works at a filling station for a man he dislikes. He is out of sympathy with the sugar and spice surface presented by the world, but when he tries to capitalize on a breach in the system he has bad luck.

In "A Night in the Country," a woman and her husband are forced to spend the night at the house of an old farmer after their car becomes stuck in the mud. "The Efficiency Expert" is a college boy on relief. He takes a summer job checking statistics on garbage trucks for the city sanitation department and blunders into an awkward situation. "The Painted Woman" deals with the adventures befalling two young house painters while working at a house in the suburbs inhabited by an aging beauty.

"The Hunters" are pursuing a prisoner escaped from an army stockade in the Southwest, each of them with a different idea about what should be done with him. "The Tornado Season" concerns the activities of a teen-age boy whose father had recently remarried, and "A Good Man Feeling Bad" deals with two men at the sea shore, one of whom is trying to persuade the other to commit suicide.

Microfilm \$2.50; Xerox \$8.80. 191 pages.

THE SENSUAL STRUT

(L. C. Card No. Mic 60-4394)

Harold Eugene Moore, Ph.D.  
State University of Iowa, 1960

Chairman: Assistant Professor Donald Justice

This novel, placed in Chicago in 1948, is the story of a young man, Jim Seekman, and his attempt to find direction and purpose in his life. During the war and immediately following he had painfully encountered death and suffering in the world (including being sterilized by the mumps) and he has resolved to avoid entanglements with other people and thus to avoid as much future pain as possible. But he also wants richness in life.

Then he goes to a party, meets a girl, Leah Blakeside, decides that for richness he needs people, and the novel

begins with him trying to resolve the contradiction between richness and uninvolvedness. As he pursues Leah, with whom he wants to live without the involvement of marriage, he is in turn pursued by a homosexual, Vivian Blair. Inevitably his attitude leads him to smash his relationship with Leah, at which time he turns to Blair and gets involved with him, painfully and fruitlessly. Confused and unmanned, he withdraws from everyone. During this time he realizes the incompleteness and evil of himself and the world, reaching a point where he feels there is no value to anything, not even his own life. Then he catches pneumonia and out of instinctive fear attempts to call Leah for help. But with his last dime he gets a wrong number and in rage and despair clumsily attempts to kill himself.

He is saved by Leah, who pays his hospital bills and then moves him into her apartment. There he lives chastely, detached and uninvolved, until his health returns. Then he begins to get increasingly involved with Leah and others, climaxed by a scene in which, jolted out of his negativism by her, they become lovers. Still he attempts to keep uninvolved, rationalizing his lack of commitment to Leah as freedom. For a time this works, but when he and Leah begin to see a married couple who practice sexual freedom, and Jim tries to put his concept of freedom into action, he begins to get increasingly involved. When he finds he cannot sleep with the wife of the other man and not hurt Leah, he chooses not to hurt Leah. But this decision enables him to see that he does hurt her by living with her and he decides to leave.

Unknown to him, Leah is in love with him and pregnant by him, and she keeps him on. He discovers her love, and when he realizes the depth of it he understands his own egotism and the selfishness of uninvolvedness. To shatter her desire to hold him, he deliberately hurts her. Just before he is to leave, however, she falls down a flight of stairs and Jim, in his terror for her safety, discovers he loves her too. But she wants a family and a man, he believes himself sterile and less than a man, and for her he resolves finally to leave her. Then he discovers she is pregnant. Unbound by love, he then also discovers his direction and purpose in life and is able to declare his love and commit himself in marriage.

It is this commitment, physical and otherwise, to love and to Leah and thus to life, which makes him realize two things: life contains death but death can be conquered with love, and true freedom is found in commitment, not in withdrawing. Yet life is not thereby complete and perfect, and it is on a note of imperfection that the novel ends.

Microfilm \$8.85; Xerox \$31.50. 698 pages.

#### SPANISH ORTHOGRAPHY IN THE THIRTEENTH CENTURY

(L. C. Card No. Mic 60-4852)

Margaret Eleanor Newhard, Ph.D.  
The University of North Carolina, 1960

Supervisor: John E. Keller

The primary purpose of this study is to describe thirteenth-century Spanish orthography, with special attention given to variations and dominant patterns of orthographic representations.

It is based on manuscripts reproduced on microfilm of ten important literary works of the thirteenth century, and

on Menéndez Pidal's edition of *Documentos Lingüísticos de España*. The selections in manuscript include: *Auto de los reyes magos*, *Disputa del alma y el cuerpo*, Berceo's *Vida de Santo Domingo de Silos* and seven works of Alfonso X. Sections of each work were examined for orthography, and all words not spelled according to modern rules were listed and compared.

The text consists of a description of the orthography, with the modern alphabet serving as a frame for the presentation of the various graphs. Under each graph is a brief summary of the phonetic evolution of the sound represented, together with a list of orthographic variants and mention of the dominant ones. Quotations from the manuscripts follow each discussion.

Although the Spanish language was still undergoing phonetic evolution in the thirteenth century, and the orthographical representation of many sounds was not yet stabilized, the majority of graphs are constant. This is especially true of initial consonants, while medial ones and atonic vowels show most variation. Yet certain patterns worthy of attention often emerge from an examination of the frequency of these graphs and their variants.

A summary of the orthography is given in the conclusions where the representations of each sound are again arranged by order of the modern alphabet. Appended are an index of the manuscripts studied, a list of abbreviations and a bibliography.

Microfilm \$2.50; Xerox \$5.80. 117 pages.

#### GERHART HERRMANN MOSTAR: A CRITICAL PROFILE.

(L. C. Card No. Mic 60-4561)

William Samelson, Ph.D.  
The University of Texas, 1960

Supervisor: Dr. Helmut Rehder

This study examines the dramatic, prose and poetic writings of Gerhart Herrmann Mostar, contemporary German novelist, journalist, playwright, and author of radio-reports. It endeavors to establish Mostar's style of writing and his thought, as well as the degree to which recent political movements and intellectual currents in Germany have affected his works.

Considering Mostar's dynamic mode of writing, he learned much from literary expressionism. Reflecting his conscience, his works demonstrate a profound concern over the administration of justice in a modern, democratic society. The evaluation of Mostar's literary and moral tendencies completes the critical profile of this writer.

Microfilm \$4.60; Xerox \$16.20. 357 pages.

#### ANATOLE FRANCE ET VOLTAIRE. [French Text].

(L. C. Card No. Mic 60-5107)

Jean Sareil, Ph.D.  
Columbia University, 1960

The influence of Voltaire on Anatole France has been often mentioned but never studied. It is obvious that he read Voltaire very thoroughly, and the first chapter of this



dissertation deals with France's knowledge of Voltaire's works.

In chapter two, I study the use that France makes of such a knowledge: on the one hand, Voltaire is for him a warrant and a source for the setting of an historical atmosphere in his XVIIIth century novels, and, on the other hand, France likes to quote, to paraphrase, to parody Voltaire. This technique is used by France, not only with Voltaire, but with all the writers he likes, and this explains why it has been possible to trace so many sources for his novels. It is not plagiarism, but creative erudition.

The influence involved in this is very superficial and indeed in style the two are altogether different one from the other. But the likeness in ideas is astounding; it is not a coincidence that these two men, so dissimilar in temper, separated by an interval of 150 years, had to fight the same enemies by using the same weapons, mainly irony, and led lives which are amazingly parallel especially in their last twenty years, when they became the champions of freedom and justice.

These two authors, who look so simple and clear, and whose message is so transparent, have puzzled their commentators with their contradictions. On every subject they presented contradictory statements, irreconcilable despite the efforts of their critics.

Under the general title of Optimism and Pessimism, I try to offer a dynamic solution of these contradictions. Voltaire and France are in fact strikingly coherent but their points of view are not static. They never attempt to solve a problem in absolute terms and, consequently, their answers must vary according to the point they start from.

As moralists, they are pessimistic about the present and optimistic about the future. For them, optimism is linked to intelligence, science, and knowledge, and consequently they believe in progress, but they are fully aware that intelligence is not a natural function of man. His instincts lead him, and passions are more powerful than reason. Society shares the same characteristics, and morality, which is an attempt at organizing life against instincts, trusts habits and prejudices rather than intelligence.

It is not difficult to foresee that, under such conditions, they will temporarily occupy many different positions - since, like Pascal, they see that man is neither angel nor beast. While they do not try to belittle mankind, they warn people against too generous plans and unrealistic dreams. Their utopias are as rational as the genre allows.

As skeptics, they are opposed to action, for they doubt that favorable results will follow it, but, at the same time, this skepticism challenges all institutions and they transcend their doubts and, rather than a pessimistic status quo, they accept the world, look for its improvement, though with small hopes and limited objectives.

Finally, I study the application of these principles to the main subjects of interest for Voltaire and France (and their interests were very much alike): religion - evil, fanaticism which is the consequence of a revealed truth - wars, armies, nationalism, justice, morality, love, society, literature.

Voltaire and France differ primarily in the matter of optimism. Living in the confident XVIIIth century, Voltaire believes that the decaying society of his time can be improved. France, belonging to a disabused generation, acts in view of his stronger doubts, and, practically speaking, holds a weaker position.

Microfilm \$9.50; Xerox \$33.75. 749 pages.

# THE USE OF AMERICAN MOTIFS BY BRITISH POETS OF THE ROMANTIC PERIOD

(L. C. Card No. Mic 60-5611)

Douglas Martin Schwegel, Ph.D.  
University of Minnesota, 1960

Many British poets of the Romantic period used American subject-matter in their verse with varying degrees of frequency and importance. This study examines the extent and the significance of American subject-matter as it appears in the non-dramatic verse written between 1789 and 1832 by nineteen British poets. References to the Americas form four distinct patterns: American exoticism, interest in the Indian, political attitudes, and admiration for George Washington.

Written accounts, including periodical articles and books of travel, constituted the chief source of information about America, but information about the New World also reached England through American citizens travelling abroad and by the reports of British subjects who had lived or travelled in America.

American exoticism was part of the general interest in strange and remote subjects that was prevalent in poetry of this period. Exoticism was in part a corollary to the Romantic interest in the specific and unusual, in contrast to the eighteenth-century concern for the general and the typical. Exotic elements drawn from the Western Hemisphere were not as common as those related to other parts of the world, especially the orient, but they did appear - commonly enough to be an important feature of Romantic poetry. American exoticism took two general forms: "picturesque exoticism," the use of details of the American landscape, and "poetic geography," the introduction of place-names for their appeal to the imagination.

The identification of the American Indian as a noble savage received its fullest poetic treatment during the early nineteenth century, but at the same time increasing knowledge of the Indian discredited the identification. The appeal of the Indian image was nevertheless so strong that it continued to appear in poetry during the remainder of the period as an ornamental device.

Many poets of the Romantic movement referred to America in connection with political ideals. Nearly every poet in doing so was concerned primarily not with the country itself but with some concept that it represented for him. In this way America provided an objective correlative for poets who wished to extol such ideals as freedom or to argue for the kind of social and political conditions that they wished to have achieved in England.

George Washington was sometimes associated with political ideals in poetic references to America, but the interest in him was so pronounced that it forms a separate motif. Although the names of several Americans appeared in the poetry of the period, there are more references to Washington than to all the rest of his countrymen combined. The poetic conception of his selfless patriotism contrasted him with contemporary European rulers and suggested parallels between him and heroes of antiquity.

There are three general characteristics of the poetic use of American motifs. They provided, first of all, a new body of subject-matter for British poets. It is significant of this novelty that American exoticism and poetic interest in the Indian were more prevalent in the work of the earlier poets of the Romantic period, and that these motifs



were generally replaced in the work of the later poets by interest in the American experiment with popular government. Secondly, Romantic poets, within the limitations of their information, strove for authenticity in their handling of American subjects. Finally, in choosing American motifs for poetic treatment, Romantic poets showed a dissatisfaction with features of their own environment. All three of these characteristics are consistent with the nature of Romanticism.

Microfilm \$3.40; Xerox \$11.95. 264 pages.

#### THE AMERICAN WAR NOVEL

(L. C. Card No. Mic 60-5112)

Daniel Spicehandler, Ph.D.  
Columbia University, 1960

This dissertation deals with the combat novels of three major wars in which America has participated: the Civil War, World War I and World War II. The first group of novels discussed is concerned with the young man who goes to war and discovers the self-knowledge which helps him find meaning and certitude in a world whose moral standards he has rejected. War, in the words of Whitman, is a moral experience which helps the young soldier to interpret his life and enables him to establish new values which will allow him to survive in a world that has lost all coherence. The accelerated maturation process that is caused by the war experience gives the young warrior a chance to establish a yardstick by which he can measure his plight and interpret his experience both for himself and for others. He returns from the wars with a new moral code which he has tested under the direst conditions. War thus becomes his "initiation" into a new life. This theme is the most prevalent in war fiction. Crane and Hemingway are fully discussed in this section.

The next group of novels are by those authors who have come to learn that the only lesson war can teach is the inhumanity of war. These novelists, who present the pacifist point of view, believe that the most criminal act man can perform is to accept war as a solution to a problem. The lesson they learned from war is that soldiers must never forget the horrors they have witnessed and that it is their duty to remind the world what a terrible thing war is. This theme predominates in the fiction about World War I and is dealt with by such writers as Dos Passos, Stallings, Trumbo and Cobb.

Many novelists present war as a social phenomenon. They, like Tolstoy, attempt to show how war affects soldier and civilian alike; how social orders are destroyed by war, and how the hierarchical structure of an army suppresses free men. The war novel as a novel of manners, so to speak, becomes the third division of this study.

The next section deals with the actual description of combat and discusses the authenticity of the war novel. Landscape, speech, mood and attitude of the fighting men differ from war to war and this individuality lends strength to the universality of the theme.

Finally, some conclusions are drawn about the direction the American war novel has taken since the Second World War. Two major trends seem to be evolving in present day war fiction. Writers such as Norman Mailer, John Horne Burns and, to some extent, James Jones accept

war as a typical human phenomenon. Leaning toward an existential approach to life, these writers believe that war is an "absurd" situation and therefore a proper experience for man. The other group, which includes such writers as John Hersey, Thomas Heggen and Harry Brown, have accepted the older idea that war is a horrible phenomenon, but that many positive lessons can be drawn from this experience. Microfilm \$3.05; Xerox \$10.80. 236 pages.

#### STEPHEN CRANE AND THE REVOLT-SEARCH MOTIF

(L. C. Card No. Mic 60-4571)

Max Roger Westbrook, Ph.D.  
The University of Texas, 1960

Supervisor: Dr. Philip Graham

The standard interpretation of Stephen Crane is that he is a naturalist, that his basic theme is pessimistic determinism. According to the majority of Crane's critics, the theme of *Maggie: A Girl of the Streets* is social determinism, "The Open Boat" shows that nature is indifferent to man's welfare, and the poems are a bitter denunciation of God. The interpretation, however, is inaccurate, for the negative aspects of Crane's stories and poems do not imply that ideals are not real. Crane's basic theme may be more satisfactorily described as the revolt-search motif: the rebellion against an institutional expression of values and the search for a non-logical expression of values. What is rejected is the popular version of ideals, not ideals themselves.

Maggie, for example, is a victim of forces over which she has no control, but Crane places the blame for her downfall on the individuals who constitute that force. Social determinism is a possibility, but it is not the definitive factor in man's relation to society. Though environment is powerful, man is held responsible for doing the best he can with what heredity and environment have given him. A similar distinction appears in "The Open Boat." Nature is indifferent to man's welfare, but that indifference does not relieve man of the responsibility of courage and brotherhood, nor does it negate the significance of man's struggle even in the face of death. Likewise, although the poems denounce the Old Testament God, they also sing the praises of a symbolic God who functions as a higher sanction for man's moral struggles in a world where no supernatural force interferes with natural forces.

Throughout the works of Crane, the theme recurs. In *The Red Badge of Courage*, Crane's major work, beliefs based on newspaper headlines and Greek heroics prove to be hollow; but the same beliefs, when based on objective reality, become real. In *The Monster* a doctor endures social ostracism and professional failure to maintain a code of values that is mocked by his own friends. *The Sullivan County Sketches* describes the absurdity of values not founded in the individual's experience, and *The Little Regiment* details the nobility of values disciplined by actuality. *War Memories* includes overt statements of the theme.

Recognition of the revolt-search motif leads not only to a new interpretation of numerous Crane stories and poems, but also to a new evaluation of Crane's mind and art.

Microfilm \$3.10; Xerox \$10.80. 238 pages.



# MATHEMATICS

## PERIODIC AUTOMORPHISMS ON BANACH ALGEBRAS

(L. C. Card No. Mic 60-5389)

Charles Hampton Chicks, Ph.D.  
University of Oregon, 1960

Adviser: Paul Civin

Let  $B$  be a complex Banach algebra on which is defined an automorphism  $T$  of period  $n$ . In Section 1 the author shows that if  $T$  is continuous,  $B = H \oplus K_1 \oplus \dots \oplus K_{n-1}$ , where  $H = \{x \in B \mid T(x) = x\}$ ,  $K = \{x \in B \mid T(x) = \gamma^i x\}$ , and  $\gamma$  is a primitive  $n^{\text{th}}$  root of unity. It is also shown that if  $S$  is a subspace of  $B$ , then  $T(S) = S$  if and only if for every  $x \in S$  with  $x = x_0 + x_1 + \dots + x_{n-1}$ ,  $x_0 \in H$ ,  $x_i \in K_i$ ,  $i = 1, \dots, n-1$ , it is true that  $x_i \in S$ ,  $i = 0, \dots, n-1$ . Special attention is given to regular, proper, and weakly proper automorphisms. It is shown that if  $B$  has no identity and  $B_1$  is the Banach algebra obtained from  $B$  by adjoining an identity, then  $T$  may be extended to an automorphism  $T_1$  on  $B_1$  which is continuous, regular, proper, or weakly proper whenever  $T$  has the corresponding property. Examples are provided to illustrate various points of the theory and to indicate how this theory differs from involution theory.

In Section 2 it is shown that a periodic automorphism  $T$  on a commutative semi-simple Banach algebra induces a homeomorphism  $\sigma$  on the maximal ideal space of  $B$ . If  $B$  is regular, then  $T$  is proper if and only if  $\sigma$  is the identity.

Minimal and minimal invariant one-sided ideals are studied in Section 3. Sufficient conditions are obtained for such an ideal to be generated by a unique invariant idempotent. Minimal one-sided ideals need not be invariant unless severe restrictions are placed on the automorphism. An example shows that without some such restriction the minimal one-sided ideals may misbehave as badly as possible.

Let  $A$  be a semi-simple annihilator Banach algebra which admits a weakly proper periodic automorphism  $T$ . Furthermore, suppose the intersection of the regular maximal invariant right ideals is zero. In Section 4 the author shows that  $H$  is a semi-simple annihilator algebra and  $A$  is the closure of the direct sum of its minimal invariant closed two-sided ideals. Moreover each such ideal is a semi-simple annihilator algebra which contains no proper invariant closed two-sided ideals. Also these ideals are continuously isomorphic to an algebra of uniform limits of finite dimensional operators on a Banach space. This representation need not contain all finite dimensional operators.

Microfilm \$2.50; Xerox \$4.20. 79 pages.

## DELAY-DIFFERENTIAL EQUATIONS AND AN APPLICATION TO A TWO-BODY PROBLEM OF CLASSICAL ELECTRODYNAMICS

(L. C. Card No. Mic 60-5595)

Rodney David Driver, Ph.D.  
University of Minnesota, 1960

The delay-differential equations considered are systems of equations having the form

$$y_i'(t) = f_i(t, y(t), y(t - \tau_2(t, y(t))), y(t - \tau_3(t, y(t))), \dots, y(t - \tau_m(t, y(t)))), \quad i = 1, 2, \dots, n,$$

where  $y(t)$  stands for  $(y_1(t), y_2(t), \dots, y_n(t))$ ; the delays,  $\tau_j(t, y(t))$  ( $j = 2, 3, \dots, m$ ), are given non-negative functions of the independent variable,  $t$ , and the dependent variables,  $y_1(t), y_2(t), \dots$ , and  $y_n(t)$ ; and each  $f_i$  ( $i = 1, 2, \dots, n$ ) is a given function of  $nm + 1$  real variables.

Such a system resembles a system of difference-differential equations. However, the delays, instead of being constants, are allowed to be functions of  $t$  and  $y(t)$ .

One specifies  $y_i(t) = \phi_i(t)$  ( $i = 1, 2, \dots, n$ ), given functions, for an interval of time  $t_0 - \alpha \leq t \leq t_0$  and then tries to determine  $y(t)$  for  $t > t_0$  so as to satisfy the delay-differential equations for  $t > t_0$  and to be continuous at  $t_0 + 0$ . By imposing continuity and Lipschitz continuity conditions on the functions  $f_i$ ,  $\tau_j$ , and  $\phi_i$  ( $i = 1, 2, \dots, n$ ,  $j = 2, 3, \dots, m$ ) and by requiring  $0 \leq \tau_j(t, y) \leq t - t_0 + \alpha$  in appropriate regions one obtains a well-set problem. This means that, for some positive  $\beta$ , there is a unique  $y(t)$  agreeing with the initial data,  $\phi(t)$ , for  $t_0 - \alpha \leq t \leq t_0$ , continuous at  $t_0 + 0$ , and satisfying the delay-differential equations for  $t_0 < t < t_0 + \beta$ . Also, the solution,  $y(t)$ , depends continuously on the initial data,  $\phi(t)$ , and the right hand sides of the equations, represented by  $f_i$  ( $i = 1, 2, \dots, n$ ) and  $\tau_j$  ( $j = 2, 3, \dots, m$ ).

Consider that two-body problem of classical (non-quantum) electrodynamics in which the two point charges are assumed to move along the  $x$ -axis. Let  $x_1(t)$  and  $x_2(t)$  be the positions of the charges and let  $v_1(t) = x_1'(t)$  and  $v_2(t) = x_2'(t)$  be their velocities at time  $t$ . Let  $q_1$  and  $q_2$  be the magnitudes of the charges and let  $m_1$  and  $m_2$  be their rest masses. So long as the charges do not collide, there is no loss of generality in assuming  $x_2(t) > x_1(t)$ . One then finds equations of motion

$$v_i'(t) = (-1)^i q_1 q_2 (4\pi\epsilon_0 m_i)^{-1} [1 - v_i^2(t)/c^2]^{3/2} r_{ji}^{-2}(t) \\ [1 + (-1)^i v_j(t - r_{ji}(t)/c)/c] \\ [1 - (-1)^i v_j(t - r_{ji}(t)/c)/c]^{-1}$$

for  $(j, i) = (2, 1), (1, 2)$  where  $\epsilon_0$  is a positive constant (used in the MKS system of units),  $c$  is the speed of light

(another positive constant), and  $r_{ji}(t)$  is defined implicitly by the equation

$$r_{ji}(t) = |x_i(t) - x_j(t - r_{ji}(t)/c)|.$$

These equations do not incorporate radiation reaction.

The equations defining  $r_{21}(t)$  and  $r_{12}(t)$  can be transformed into delay-differential equations. This provides a system of four delay-differential equations to which the analysis of the first part of the paper applies.

One specifies initial trajectories,  $x_1(t) = \theta_1(t)$  and  $x_2(t) = \theta_2(t)$  for a finite interval of time,  $t_0 - \alpha \leq t \leq t_0$ , subject to the following requirements: 1) The implicit equations for  $r_{21}(t)$  and  $r_{12}(t)$  are solvable at the instant  $t_0$ , 2)  $\theta_2(t_0) > \theta_1(t_0)$ , and 3) the velocities,  $\theta_1'(t)$  and  $\theta_2'(t)$ , are Lipschitz continuous and have magnitudes less than  $c$  for  $t_0 - \alpha \leq t \leq t_0$ . Then, requiring continuity of  $x_i(t)$  and  $v_i(t)$  at  $t_0$  ( $i = 1, 2$ ), the trajectories are determined for all  $t > t_0$  unless and until the charges collide.

If two point charges have the same sign they will not collide. If they have opposite signs they may or may not collide, depending on the initial data.

If two charges collide at  $t_0 + \beta$  then, as  $t \rightarrow t_0 + \beta$ ,  $v_1(t) \rightarrow c$  and  $v_2(t) \rightarrow -c$ . In case the charges do not collide then  $x_2(t) - x_1(t) \rightarrow \infty$  as  $t \rightarrow \infty$ .

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#### ON DIOPHANTINE APPROXIMATIONS

(L. C. Card No. Mic 60-5391)

Lawrence Carl Eggen, Ph.D.  
University of Oregon, 1960

Adviser: Ivan Niven

Following a brief survey of continued fractions (in which no new results are given) we solve the problem of finding the best possible constant  $c_m$  such that for any irrational number  $\theta$  not equivalent to  $(5^{1/2} - 1)/2$ , there exist at least  $m$  rational approximations  $p/q$  satisfying

$$(1) \quad |\theta - p/q| \leq 1/(c_m q^2).$$

More generally we answer the question: What is the best possible constant  $c_m$  if we want at least  $m$  rational solutions  $p/q$  to the inequality (1) for all irrational numbers  $\theta$  which have, in their continued fraction expansions, infinitely many partial quotients greater than or equal to  $n$ .

Other situations are considered where there is a well established theory of "infinitely many approximations," and we treat the corresponding problem of "at least one approximation."

Let  $\theta$  be irrational,  $\sigma$  real and positive,  $s, a, b$  integers with  $s \geq 1$ . Then if  $\theta$  is not equivalent to  $(5^{1/2} - 1)/2$ , there are infinitely many rational approximations  $p/q$  such that

$$(2) \quad q^2 |\theta - p/q| < s^2 (27 + \sigma) / (28(7^{1/2}) q^2)$$

with  $p \equiv a \pmod{s}$  and  $q \equiv b \pmod{s}$ . If, further,  $\theta$  is not equivalent to  $(7 - 7^{1/2})/14$  or if  $s \not\equiv 0 \pmod{14}$ , then we may replace  $(27 + \sigma)/(28(7^{1/2}))$  by the smaller value  $(1 + \sigma)/8^{1/2}$ . This is an extension of a theorem of J. F. Koksma.

Next, for real  $\theta$  define

$$\mu(\theta) = \liminf \{ q^2 |\theta - p/q|; p, q \text{ integers, } q \neq 0 \}.$$

We show that the average value of  $\mu$  over the closed interval from 0 to 1 is zero. The same property is established for some other functions similar to  $\mu$ .

The results stated thus far are concerned with real numbers only. Turning to the complex case, we consider some problems in the approximation of complex numbers by complex (or gaussian) integers. We also discuss the possibility of a theory of continued fractions for complex numbers, although we are not able to devise one.

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#### THE BOUNDARY VALUE PROBLEM FOR AN ORDINARY NONLINEAR DIFFERENTIAL EQUATION OF SECOND ORDER

(L. C. Card No. Mic 60-5573)

Leonard DuBois Fountain, Ph.D.  
The University of Nebraska, 1960

Adviser: Lloyd K. Jackson

Let  $Y$  be a family of functions, each of which is defined and of class  $C^{(1)}$  on some sub-interval of  $[a, b]$ , and let  $Y$  be such that through any point of the strip  $a \leq x \leq b$  in the  $x$ - $y$  plane there passes a unique member of  $Y$  with a given slope  $c$ , through any two points of this strip which are sufficiently close together there passes a unique member of  $Y$ , and if  $y_1$  and  $y_2$  are members of  $Y$ , then  $y_1(x_1) \leq y_2(x_1) + M$  and  $y_1(x_2) \leq y_2(x_2) + M$  imply that  $y_1(x) \leq y_2(x) + M$  on  $[x_1, x_2]$ , for any  $x_1 < x_2$  in  $[a, b]$  and  $M \geq 0$ . A sub- $Y$  function is a bounded function  $g(x)$  which is defined on a subinterval of  $[a, b]$  and is such that for any  $y$  in  $Y$ ,  $g(x_1) \leq y(x_1)$  and  $g(x_2) \leq y(x_2)$  imply  $g(x) \leq y(x)$  on  $[x_1, x_2]$ . A super- $Y$  function may be defined similarly by reversing the inequalities. These functions have many properties similar to those of generalized convex and concave functions as defined by Beckenbach. They have at most a countable number of discontinuities of "jump" type and on any interval of continuity they have a finite derivative almost everywhere.

It can be shown by known theorems that the set of solutions of the differential equation  $y'' = f(x, y, y')$  satisfies the requirements for the family  $Y$  and hence that sub- $Y$  and super- $Y$  functions may be defined with respect to this equation, provided that  $f(x, y, y')$  is continuous with continuous partial derivatives  $f_y$  and  $f_{y'}$  on the region  $R$ :  $a \leq x \leq b$ ,  $-\infty < y < +\infty$ ,  $-\infty < y' < +\infty$ , with  $f_y \geq 0$  on  $R$ . Such sub- $Y$  and super- $Y$  functions may be characterized by certain differential inequalities involving the function  $f(x, y, y')$ . An under-function with respect to the boundary value problem  $y'' = f(x, y, y')$ ,  $y(a) = A$ ,  $y(b) = B$  is a continuous function  $\phi(x)$  defined on  $[a, b]$  which is a sub- $Y$  function with respect to the differential equation such that  $\phi(a) \leq A$  and  $\phi(b) \leq B$ . An over-function with respect to this boundary value problem is similarly defined to be a continuous super- $Y$  function  $\psi(x)$  such that  $\psi(a) \geq A$  and  $\psi(b) \geq B$ .

Assuming that for the boundary value problem there



exist at least one over-function and one under-function of class  $C^{(1)}$  on  $[a, b]$ , let  $H^*(x) = \inf [\psi(x) | \psi \in \{\psi\}]$ , where  $\{\psi\}$  is the set of all over-functions.  $H^*(x)$  is both a sub-Y and a super-Y function and is identical with a solution of the differential equation except at the points of a nowhere dense set of measure zero. At these points the right and left derivatives of  $H^*(x)$  become infinite. Also  $H^*(x)$  must either be continuous at  $x = a$  and  $x = b$  and satisfy the given boundary values there or else its derivatives on the right and left respectively become infinite.  $H^*(x)$  can be considered a generalized solution of the boundary value problem.

If a condition which is due to Nagumo is satisfied by  $f(x, y, y')$  in addition to the previous assumptions, then  $H^*(x)$  cannot have infinite derivatives and hence it will be the solution of the boundary value problem in the classical sense. Other conditions may be imposed on  $f(x, y, y')$  which coupled with restrictions on the boundary values  $A$  and  $B$  will insure that  $H^*(x)$  is a solution of the boundary value problem even in cases where the Nagumo condition is not satisfied.

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#### METHODS OF OPTIMUM FEEDBACK CONTROL

(L. C. Card No. Mic 60-5603)

Ernest Bruce Lee, Ph.D.  
University of Minnesota, 1960

Adviser: K. Ogata

In the thesis are considered problems of determining optimum control functions for systems of ordinary differential equations. The results have a direct application to the optimum control of certain processes which can be described by ordinary differential equation models. The problem is formulated as a variational one by using mathematical criteria to indicate controller goodness. Tests are then given for establishing when an optimum controller exists and for the form of the optimum controller. Methods are given which can be used in computing the optimum control function.

The first part of the thesis is concerned with the minimum energy, minimum response time, and minimum following error control of the linear process-equations. The second part of the thesis is concerned with the time optimal and minimum energy control of the nonlinear process-equations.

The usual restrictions that have been put on the control function are that it is a piecewise continuous function, that it is bounded or is in some other manner limited, and that it is physically realizable. It is generally assumed that the process-equation has some desirable state to which the control is to bring the process in an optimum fashion. The desired process-state is assumed a given or to be determined function of a single independent variable.

Particular attention has been made to the time optimum control of the second order process-equation:  $\ddot{x} + f(\dot{x}) + g(x) = y$ ,  $|y| \leq b$ .

Microfilm \$2.50; Xerox \$6.20. 129 pages.

#### ON THE THEORY OF ALGEBRAIC EXTENSIONS OF A NORMED ALGEBRA

(L. C. Card No. Mic 60-5604)

John Albert Lindberg, Jr., Ph.D.  
University of Minnesota, 1960

Let  $A$  be a commutative Banach algebra with a multiplicative identity,  $\alpha(x)$  a monic polynomial over  $A$ , and  $B = A[x]/(\alpha(x))$ .<sup>1</sup> Let  $H(A)$  and  $H(B)$  denote the spaces of continuous multiplicative linear functionals on  $A$  and  $B$ , respectively. Then  $H(B)$  is identifiable with  $\{(h, \lambda) : h \in H(A), \lambda \text{ complex, and } (h, \lambda)\alpha(x) = 0\}$ , where  $(h, \lambda)\{\sum a_i x^i + (\alpha(x))\} = \sum \hat{a}_i(h)\lambda^i$ .<sup>2</sup> The first main result is: Let  $(X, p, Y)$  be a fiber space where  $p: X \rightarrow Y$  is onto and the topologies on  $X$  and  $Y$  are compact and  $T_2$ . Then a necessary and sufficient condition that there exist a Banach algebra  $A$ , a monic polynomial  $\alpha(x)$  over  $A$ , and homeomorphisms  $\gamma$  and  $\varphi$  such that  $\pi \circ \gamma = \rho \circ \varphi$ , where  $\pi(h, \lambda) = h$  for  $(h, \lambda) \in H(B)$ , is that the following two conditions hold:

- (i) there exists  $f \in C(X)$  such that  $f(x_1) \neq f(x_2)$  if  $x_1 \neq x_2$  but  $p(x_1) = p(x_2)$ , and
- (ii) there exists an integer (positive)-valued function  $M'$  on  $X$  such that if  $y_0 \in Y$  and  $p^{-1}(y_0) = \{x_{0i} : i \in I\}$ ,  $I$  some index set (necessarily finite), then there are disjoint open sets  $V_i$  in  $X$  such that (a) for each  $i \in I$ ,  $x_{0i} \in V_i$ ,  $p(V_i) = V$  is open in  $Y$ , (b)  $p^{-1}(V) = \bigcup_{i \in I} V_i$ , and (c)  $y \in V$  implies that  $M'(x_{0i}) = \sum_{x \in p^{-1}(y) \cap V_i} M'(x)$ .

For the necessity part, we take the function  $M \circ \gamma^{-1}$ , where  $M(h, \lambda)$  denotes the multiplicity of  $\lambda$  as a root of  $(h, \lambda)\alpha(x) = 0$ .

Let  $S(\alpha(x), A)$  be the set of points  $h \in H(A)$  such that  $\pi$  is not a local homeomorphism at some point of the fiber  $\pi^{-1}(h)$ . Then we have:  $S(\alpha(x), A)$  is nowhere dense in  $H(A)$ .

The main factorization theorem proved is: Let  $A$  be semi-simple. Suppose that  $H(B) = X_1 \cup X_2 \cup \dots \cup X_m$  where

- (i) the  $X_n$  are disjoint and clopen in  $H(B)$ ,
  - (ii)  $m_n = \sum_{(h, \lambda) \in X_n \cap \pi^{-1}(h)} M(h, \lambda)$  is independent of  $h \in H(A)$ , and
  - (iii) there exist positive integers  $k_1, k_2, \dots, k_m$  such that  $M(h, \lambda)$  is an integral multiple of  $k_n$  if  $(h, \lambda) \in X_n$ .
- Then there are monic polynomials  $\alpha_1(x), \alpha_2(x), \dots, \alpha_m(x)$  over  $A$ , where the degree of  $\alpha_n(x)$  is  $m_n/k_n$ , such that

$$\alpha(x) = \alpha_1(x)^{k_1} \alpha_2(x)^{k_2} \dots \alpha_m(x)^{k_m}.$$

As a corollary, we have: If  $f \in C(HA)$ , if  $(h, f(h))\alpha(x) = 0$ , and if  $M(h, f(h))$  is locally constant on  $H(A)$ , then there exists an  $a \in A$  such that  $\alpha(a) = 0$  and  $\hat{a} = f$ .

It is shown that if  $A$  is self-adjoint and if  $S(\alpha(x), A) = \emptyset$ , then  $B$  is also self-adjoint. An example shows that if  $S(\alpha(x), A) \neq \emptyset$ , then  $B$  may not be self-adjoint. In contrast to this situation, we have that if  $A$  is regular, then  $B$  is also regular. As a corollary we have: Suppose  $A$  is regular, self-adjoint, and semi-simple. If for each  $h \in S(\alpha(x), A)$ , there is a (weak\* closed) neighborhood  $V$  of  $h$  in  $H(A)$  such that  $\alpha(x) + k(V)$  factors into linear factors over  $A/k(V)$ , where  $k(V)$  is the kernel of  $V$ , then there exists a regular, self-adjoint, and semi-simple extension of  $A$  in which  $\alpha(x) = 0$  has a solution.

Let  $G(B:A)$  denote the group of all automorphisms

$g$  of  $B$  onto  $B$  such that  $g(a) = a$ , all  $a \in A$ ,  $E(HB):H(A)$  the group of all homeomorphisms  $\gamma$  of  $H(B)$  onto  $H(B)$  such that  $\pi \circ \gamma = \pi$ , and  $(*)$  the usual mapping of a homomorphism  $\varphi$  onto its adjoint  $\varphi^*$ . The following results are obtained: If  $g \in G(B:A)$ , then  $g^* \in E(H(B):H(A))$  so that  $(*)$  is an anti-homomorphism of  $G(B:A)$  into  $E(H(B):H(A))$ . If the discriminant  $d$  of  $\alpha(x)$  is not a topological zero divisor, then  $(*)$  is one-to-one and  $G(B:A)$  is a torsion group where the orders of the elements are uniformly bounded by  $n!$ ,  $n = \text{degree of } \alpha(x)$ . Moreover, if  $d^{-1} \in A$ , then  $(*)$  is also onto.

Let  $\varphi: A_1 \rightarrow A_2$  be a ring isomorphism (onto), where the  $A_i$  are Banach algebras. Then the adjoint mapping  $\varphi^*$  defined by  $\hat{a}(\varphi^*(h)) = \varphi(a) \wedge (h)$ ,  $h \in H(A_2)$ , is a weak\* continuous mapping, and hence, a homeomorphism. It is shown that if  $B_i = A_i[x_i]/(\alpha_i(x_i))$  ( $\deg \alpha_1(x_1) = \deg \alpha_2(x_2)$ ), and if the discriminants of the  $\alpha_i(x_i)$  are invertible in  $A_i$ , then  $\varphi$  is extendable to an isomorphism  $\tilde{\varphi}: B_1 \rightarrow B_2$  if and only if there exists a homeomorphism  $\theta: H(B_1) \rightarrow H(B_2)$  such that  $\pi_1 \circ \theta = \varphi^* \circ \pi_2$ , where  $\pi_i: H(B_i) \rightarrow H(A_i)$  is the usual projection.

1. For the norm on  $B$ , see Arens and Hoffman, Algebraic Extensions of Normed Algebras, Proc. Amer. Math. Soc., 7(1956), pp203-210.
2. See the Arens and Hoffman paper.

Microfilm \$2.50; Xerox \$4.20. 78 pages.

#### HOMOTOPY GROUPS OF CERTAIN DELETED PRODUCT SPACES

(L. C. Card No. Mic 60-4653)

Clarence Wayne Patty, Ph.D.  
University of Georgia, 1960

Supervisor: T. R. Brahana

The deleted product space  $X^*$  of a topological space  $X$  is the subset of the cartesian product of  $X$  with itself consisting of pairs of distinct points. In this paper, we compute the minimal number of elements in a system of generators for the fundamental group of the deleted product space of any connected, finite, 1-dimensional polyhedron which is not an arc. First, we compute the fundamental group of: (1) a triod, and (2) a simple closed curve. Then, formulas are obtained which show that: (1) If  $X$  is obtained from  $A$  by adding a 1-simplex incident to one vertex and if a system of generators for  $\pi_1(A^*)$  consists of the minimal number  $p$  of elements, then there is a system of generators for  $\pi_1(X^*)$  consisting of the minimal number  $p + 2n - 4$  of elements, where  $n$  is the order in  $X$  of the incident vertex. (2) If  $X$  is obtained from  $A$  by addition of a 1-simplex in such a way that it is then incident to two vertices of order 2 and if a system of generators for  $\pi_1(A^*)$  consists of the minimal number  $p$  of elements, then there is a system of generators for  $\pi_1(X^*)$  consisting of the minimal number  $p - 2n + 2$  of elements, where  $n$  is the deleted product number of  $A$  with respect to the two incident vertices. An important fact about this deleted product number is that it is obtained by considering only the structure of  $A$ . Every connected, finite, 1-dimensional polyhedron which is not

an arc can be realized by starting with a triod or a simple closed curve and using additions of the types described above.

In the process of proving the above, we show that if  $X$  is any connected, finite, 1-dimensional polyhedron which is not an arc, then there is a system of generators for  $\pi_1(X^*)$  which consists of the same number of elements as the number of elements in a basis for  $H_1(X^*, Z_2)$ , where  $Z_2$  denotes the integers mod 2. We also show that there is a presentation of  $\pi_1(X^*)$  with the minimal number of generators and certain relations, where each relation is a commutativity relation between elements.

Finally, we show that the higher homotopy groups of the deleted product space of any connected, finite, 1-dimensional polyhedron which is not an arc vanish.

Microfilm \$2.50; Xerox \$3.00. 58 pages.

#### INVERSE LIMIT SPACES

(L. C. Card No. Mic 60-4655)

Jack Segal, Ph.D.  
University of Georgia, 1960

Supervisor: Professor M. K. Fort, Jr.

This paper is concerned with inverse systems of spaces and inverse limit spaces. The spaces of the inverse system will be called factor spaces; the maps of the inverse system will be called bonding maps. Certain fundamental properties of inverse systems of spaces and inverse limit spaces will be developed. On the basis of these properties, two projects will be undertaken. The first is an investigation of certain topological properties of the inverse limit space and how restrictions on the factor spaces and bonding maps affect these properties. Secondly, application of inverse limit spaces is made in determining the homology and dimension properties of the hyperspace of a continuum.

In Section 1 the definitions and some basic properties of an inverse system of spaces and the inverse limit space are given. Some examples are given at the end of the section. In Sections 2, 3, and 4, the effect of restricting factor spaces and bonding maps is studied and results on embedding, homogeneity, factoring, and indecomposability are obtained.

In Section 5,  $C(X)$  is shown to be acyclic in all dimensions and sufficient conditions for the finite dimensionality of  $C(X)$  are obtained without requiring that  $X$  be locally connected. In Section 6 it is shown that if  $X$  is not locally connected or is a linear graph, then  $C(X)$  is not homogeneous. Microfilm \$2.50; Xerox \$3.00. 33 pages.



# AN ESTIMATE OF CORRELATION CORRECTED FOR ATTENUATION AND ITS DISTRIBUTION

(L. C. Card No. Mic 60-4870)

Edney Webb Stacy, Ph.D.  
The University of North Carolina, 1960

Supervisor: Harold Hotelling

A model appropriate to the study of reliability coefficients and correlation corrected for attenuation is examined by use of multivariate analysis techniques. Given two sets of  $p$  observable variates, each variate having a specified structure (true component plus a random error), the covariance matrix is established. A joint  $(2p)$ -variate normal distribution is assumed for the variates, the means being zero and the covariance matrix being positive definite (patterned). A test is provided for deciding the question of equal versus unequal reliability coefficients. Canonical correlations and variates are derived for the model. It is found that there is at most one non-vanishing canonical correlation and that the corresponding canonical variates are independent of specific values for the covariance matrix elements. This gives rise to quasi-canonical correlations and variates. In the case of equal reliability coefficients, maximum likelihood estimates of covariance matrix elements are obtained under conditions which are less restrictive than conditions resulting from assumed structures of the variates. Use of the less restrictive conditions leads to anomalies which are discussed. A function of the abovementioned estimators is proposed as an estimate of correlation corrected for attenuation and is denoted by  $w$ . Asymptotic distributions are derived for all the estimators (including  $w$ ) and the exact distribution of  $w$  is given. These distributions are functions of the reliability coefficient and the correlation corrected for attenuation. Some unsolved problems which relate to the present research and possible extensions to the theory are discussed. Microfilm \$2.50; Xerox \$5.00. 98 pages.

# LOCAL INTEGRABILITY IN $\sigma$ -FINITE MEASURE SPACES AND KÖTHE SPACES

(L. C. Card No. Mic 60-4222)

Robert Roy Welland, Ph.D.  
Purdue University, 1960

Major Professor: Casper Goffman

Let  $(M, \mu)$  be a  $\sigma$ -finite measure space, and  $\mathcal{h}$  the algebra of measurable sets modulo sets of measure zero. A cover  $T$  of  $M$  is a subfamily of  $\mathcal{h}$  such that

- i)  $T$  is a subalgebra, and
- ii) for each  $C \in \mathcal{h}$  a sequence  $(A_i)$  in  $T$  exists such that  $C \subset \bigcup A_i$ .  $f_A$  denotes an equivalence class of measurable functions such that,  $f \in f_A$  implies the support of  $f \in A$  and  $f, g \in f_A$  implies  $f = g$  almost everywhere. A set  $(f_A)_{A \in T}$  is said to be coherent if  $\chi_A f_B = \chi_B f_A$ ,  $A, B \in T$ . Here  $\chi_A$  is the equivalence

class of characteristic functions  $\chi_A$ ,  $A \in \mathcal{h}$ . The measure space  $M$  is said to have the piecing property if an equivalence class of functions  $f$  of a suitable type exists such that  $\chi_A \cdot f = f_A$ ,  $A \in T$ . This property is independent of the cover  $T$  and implies the Radon-Nikodym theorem, that is, the Radon-Nikodym theorem holds for  $\sigma$ -finite measure spaces having the piecing property.

In the second chapter two spaces are predominant. The first is the space  $\Omega_T$  of equivalence classes of  $T$ -locally integrable functions.  $f \in \Omega_T$  if  $\chi_A \cdot f \in L^1(M, \mu)$  for every  $A \in T$ , and  $f_1, f_2 \in f$  if  $\chi_A \cdot f_1 = \chi_A \cdot f_2$  almost everywhere for all  $A \in T$ . The second,  $O_T$ , is the inverse limit of the spaces

$$\mathcal{L}_A = \{f \in L^1(M, \mu) : \chi_A \cdot f = f\}.$$

The set of spaces  $O_T$  may be partially ordered. It is shown that a maximal space  $O_T$  exists if and only if  $M$  is totally atomic. The set

$$(\mathcal{h}_A : \mathcal{h}_A(f) = \int_A |f| d\mu, f \in \mathcal{L}_A, A \in T)$$

of semi-norms gives  $\Omega_T$  a topology, while  $O_T$  gets a topology as an inverse limit (the spaces  $\mathcal{L}_A$  are Banach spaces). It is shown that  $\Omega_T$  is isomorphic and uniformly equivalent with a subspace of  $O_T$ . This isomorphism  $\varphi$  is onto if and only if  $M$  has the piecing property.

Let  $L^1 = (F \in O_T : \varphi^{-1}(F) \in L^1(M, \mu))$ . For each subset  $\Gamma \subset O_T$  define

$$\Lambda = \Lambda(\Gamma) = (F \in O_T : F \cdot G \in L^1_T \text{ for all } G \in \Gamma)$$

and

$$\Lambda^* = \Lambda(\Lambda).$$

These spaces are vector lattices called Köthe spaces, and  $\Lambda^{**} = \Lambda$ . The pair  $(\Lambda, \Lambda^*)$  is put in weak duality by the bilinear form

$$(F, G) = \int \varphi^{-1}(F \cdot G) d\mu$$

To each Köthe space  $\Lambda$  is assigned a set of compatible topologies  $K_W$ .  $(\Lambda, K_W)$  denotes the topological vector lattice with the topology  $K_W$ .  $\Lambda$  is conditionally complete, while  $(\Lambda, K_W)$  is topologically complete. Assuming  $M$  has finite measure and that  $M \in T$ , then  $\Lambda$  is sequentially complete for the weak topology. Concerning the set of topologies, there is a weakest and a strongest; the strongest is denoted by  $S$ .

The normal closure of a subset  $A \subset \Lambda$  is the set of  $F \in \Lambda$  such that  $|F| \leq |G|$  for some  $G \in A$ . It is shown that the normal closure of a weakly bounded set is again weakly bounded.

A normal convex subset  $A \subset \Lambda$  is said to be admissible if for every nondecreasing sequence  $(F_n)$  of nonnegative elements of  $A$ , an  $F \in A$  exists with  $F_n \leq F$ ,  $n = 1, 2, \dots$ . Admissible sets in  $\Lambda$  are weakly bounded and each weakly bounded set is contained in an admissible set. The space  $(\Lambda, S)$  is a Banach space if and only if  $\Lambda$  contains an absorbing admissible subset.  $(\Lambda, S)$  is a Banach space if and only if  $(\Lambda^*, S^*)$  is a Banach space. In this case the two spaces are related by a Hölder type inequality. Necessary and sufficient conditions are given under which  $(\Lambda, S)$  is a Fréchet space. It is shown that when  $(\Lambda, S)$  is a Fréchet space but not a Banach space, then  $(\Lambda^*, S^*)$  is not metrizable. If  $\Lambda^*$  contains a strong unit it is shown that  $(\Lambda, S)$  is a Banach space and  $S = K_W$  for every Köthe topology  $K_W$ .

Microfilm \$2.50; Xerox \$4.40. 81 pages.

# HOMOLOGY AND COHOMOLOGY FROM RINGS OF FUNCTIONS

(L. C. Card No. Mic 60-6141)

Paul John Zwier, Ph.D.  
Purdue University, 1960

Major Professor: Merrill E. Shanks

This thesis is concerned with obtaining cohomology and homology from rings of functions. A basic tool used is to construct gratings in the sense of Henri Cartan. The work consists of two parts. The first of these, Chapter I, continues the work of Hu and Giever in constructing homology and cohomology using rings of functions on general topological spaces. The second part, Chapter II, deals with manifolds and gives a partial solution to the kinds of boundary and coboundary operators which lead to cohomology and homology.

Thus in the first chapter cohomology and homology are constructed on completely regular topological spaces. In the first section cohomology is considered and a grating is constructed which is shown to be an R-grating which is R-simple and fine in the sense of Cartan where R is the reals. Thus, using Cartan's machinery, it is shown that for the compact, infinitely differentiable manifold, the derived ring of the grating constructed is isomorphic with the derived ring of the ring of differential forms on the manifold. It is also shown that the cohomology groups of the derived ring are isomorphic with the Alexander-

Kolmogoroff-Lefschetz cohomology groups for completely regular topological spaces.

The second section of this chapter deals with homology on general topological spaces. Homology is constructed using the continuous functions on the space which is shown to be isomorphic with the Alexander-Kolmogoroff-Lefschetz homology theory for metric spaces.

Chapter II is concerned with cohomology and homology on infinitely differentiable manifolds. In the first section the grating of alternating contravariant tensors on the manifold is constructed globally from the ring of infinitely differentiable functions. A coboundary operator is defined and it is shown that the derived ring of the grating obtained is isomorphic with the derived ring of the grating of differential forms on the manifold. The section concludes with a consideration of the possible cohomology operators that can be defined on the ring of alternating contravariant tensors. It is shown that the choice is actually extremely limited under certain conditions and that each choice is intimately related to the classical exterior derivative operator.

The second section of Chapter II deals with homology on infinitely differentiable manifolds. Again the alternating contravariant tensors are used, but now as chains, and a boundary operator is defined producing homology groups which are isomorphic with the cohomology groups obtained from the derived ring of the ring of differential forms. Finally, some conditions are given which characterize the boundary operator.

Microfilm \$2.50; Xerox \$4.00. 71 pages.

## MINERALOGY

### PETROLOGY OF THE VAQUEROS FORMATION NEAR GAVIOTA, CALIFORNIA.

(L. C. Card No. Mic 60-5435)

Gordon Conrad Greder, Ph.D.  
The Pennsylvania State University, 1960

The Vaqueros formation near Gaviota, California is a transgressive sandstone, lower Miocene in age. The purpose of the investigation is 1) to make the first thorough petrographic description of the Vaqueros near Gaviota, 2) to establish petrographic criteria for distinguishing between the Vaqueros and the underlying regressive Oligocene Alegria formation, and 3) to draw paleogeologic inferences from the petrographic data.

Outcrops were examined and sampled during two summers of field work. Five Vaqueros and two Alegria sections were measured in detail. The petrographic analysis consisted of 1) modal analysis of mineral components, 2) measurement of grain size in thin section, 3) 100-grain counts of accessory minerals, and 4) roundness estimates.

The Vaqueros ranges in composition from an arkosic clastic limestone to a calcareous arkose, and in size from a very fine-grained sandstone to a sandy conglomerate. It is most commonly a gray coarse-grained calcareous subangular arkose. The most common non-opaque acces-

sory is sphene, and there is an unusual occurrence of topaz in some samples. Overgrowths on microcline are common; plagioclase is frequently replaced by calcite. The cement is sparry calcite in all specimens, and there is no matrix. Most of the pebbles are microquartz and rock fragments about 10 mm in diameter, ranging up to 160 mm in length. Quartz and feldspar content is directly proportional to grain size. The Vaqueros ranges in thickness from about 6 m at Gaviota Canyon to 73 m at Guillermo Canyon, averaging about 30 m.

The Alegria formation contains a higher average percentage of quartz than the Vaqueros (44% vs 23%), and also a higher proportion of feldspar (24% vs 12%). The average length of quartz grains in thin sections is greater in the Vaqueros than in the Alegria (0.65 mm vs 0.34 mm). The same is true of feldspar (0.75 mm vs 0.34 mm). Both quartz and feldspar are more rounded in the Vaqueros than in the Alegria. The ratio of epidote to sphene is lower in the Vaqueros (up to 0.36) than in the Alegria (down to 0.69).

The source area of the Vaqueros is inferred to have been one of sedimentary and volcanic rocks, locally intruded by pegmatite dikes, with a more distant area of granitic rocks, all undergoing deformation by high-angle faulting. The topography was steep in places. Weathering was extensive in areas of gentle slope in a warm and humid climate.



The Vaqueros is presumably a shoreline deposit consisting of sand and gravel that was concentrated along a slowly-moving shoreline during the upper Oligocene, and was finally deposited during a rapid transgression in the lower Miocene. It was cemented with calcite before the uplift of the Santa Ynez Range.

Microfilm \$2.50; Xerox \$7.20. 152 pages.

RELATIONSHIPS BETWEEN URANIUM  
AND SOME OTHER TRACE ELEMENTS  
IN PYRITE, GALENA, AND SPHALERITE  
FROM VEIN DEPOSITS.

(L. C. Card No. Mic 60-5460)

William Peter Shulhof, Ph.D.

The Pennsylvania State University, 1960

The relationships between uranium and some other trace elements in pyrite, galena and sphalerite from vein deposits have been studied to determine their value as a prospecting tool for "hidden" uranium, and to determine how they may aid in interpreting their environment of formation. From about 600 specimens taken in 16 Western mining districts, the analyses (for uranium, silver, arsenic, bismuth, cobalt, manganese, molybdenum, nickel, antimony and tin) of 255 specimens were selected for investigation.

Samples were analyzed for uranium by radiometry and checked by fluorimetry, while an emission spectroscopic method was improved to analyze for the remaining elements.

Reliability of the spectroscopic method was evaluated with the Chain Block design Analysis of Variance, the design of which yields maximum information for the minimum number of replicate analyses. The data obtained were analyzed for the relationships sought by multiple regression, analysis of variance, and correlation statistics.

The more important findings are as follows:

The relationship of trace elements in sulfides is more direct than with uranium in bulk ore.

Other variables than those anticipated confound the relationships between uranium and the other trace elements. Two of these variables were identified, although it was obvious that still others played a major role.

The mining districts studied are similar in those variables which the trace element assemblage reflect.

An interdependence exists between uranium and the other trace elements which varies from district to district.

Relationships between uranium and other trace elements may differ in individual mines from the district as a whole. To best understand the significance of these relations, districts should be redefined if possible.

Judicious use of the relationships found could result in a useful guide to "hidden" uranium ore. Virtually no conclusions could be deducted which would illuminate the geochemical environment of the deposits; those factors are masked by the numerous variables discovered in the course of this work. More detailed studies will be necessary to generalize the relationships found and to establish the bases of the geochemical relationships sought. Suggestions for such studies are discussed in detail.

Microfilm \$2.50; Xerox \$5.40. 108 pages.

A COMPARISON OF  
THREE QUARTZITES

(L. C. Card No. Mic 60-5467)

George V. Wood, Ph.D.

The Pennsylvania State University, 1960

Forty samples of each of the Tuscarora, Oriskany, and Homewood Quartzites from Pennsylvania (one outcrop of the Oriskany Quartzite was in West Virginia) were studied petrographically and chemically. The samples from each quartzite were divided into two populations of twenty in order to evaluate the within quartzite multiple regression relationships using bulk density as the dependent variable.

No significant differences were found between the two regression lines within the Tuscarora and Oriskany Quartzites but the two regression lines of the Homewood Quartzite were found to have heterogeneous residual sums of squares.

A discriminant function was constructed using quartz content, silica cement content, mean size of the long axis of quartz in phi units and  $\text{Fe}_2\text{O}_3$  content as variables and was found to be efficient in differentiating between refractory and non-refractory outcrops of the Tuscarora Quartzite.

The means and standard deviations of the frequency distributions of the mineral constituents were obtained for each population by point-counting.

Using the goodness of fit of the observed distributions to the theoretical distribution models of constant probability, an empirical background was established for typifying the textural arrangement of the mineral constituents. The Oriskany Quartzite was established as a 'massive' rock, with respect to the detrital elements, while the Tuscarora and Homewood Quartzites were shown to be finely banded and coarsely banded respectively (at least as far as the outcrops under consideration were concerned).

The degree of fit of the distribution of each detrital mineral element to the model was found to be constant within and across all elements.

The distribution of the silica cement however was different. In the Homewood Quartzite the cement is homogeneous, in the Tuscarora it is layered, while in the Oriskany it is layered in one outcrop and homogeneous in the other.

The first four moments of the distributions of both long and short axes of quartz in grains expressed phi units were determined by thin section measurement. The distributions were shown to be essentially normal.

The means and standard deviations of the  $\text{Fe}_2\text{O}_3$  and  $\text{Al}_2\text{O}_3$  contents of each sample determined by spectrographic analysis are recorded.

The only significant correlations that are invariant across all sampling levels of these quartzites are between the means of the long 'a' and short 'b' axes of quartz grains and between their respective sortings.

The arrangement of the alumina-rich minerals is shown to be of more importance than the mean  $\text{Al}_2\text{O}_3$  content when considering the beneficiation potential of quartzites and it is suggested that the quartzite of the Pottsville Series, Lower Pennsylvanian would make a good starting point in the search for new refractory quartzites.

Microfilm \$2.50; Xerox \$8.00. 172 pages.

## MUSIC

### AN EVALUATION OF A TECHNIQUE EMPLOYING THE USE OF THE MAGNETIC TAPE RECORDER IN TEACHING OF STUDENTS OF BRASS INSTRUMENTS

(L. C. Card No. Mic 60-5641)

Millard Robert Biggs, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor Neal E. Glenn

The purpose of this investigation was to determine the value of the tape recorder as an aid in teaching private brass students. The value of the recorder as a teaching aid in the area of music has been well established with instructors.

Numerous studies have indicated that audio-visual aids have a positive effect on learning. The armed services made considerable use of audio-visual devices during World War II.<sup>1</sup> Extensive development and utilization of such equipment has been evident in recent years. Educators such as Peterson,<sup>2</sup> Barnard,<sup>3</sup> and Andrews<sup>4</sup> have encouraged their use in music.

As a preliminary step in this investigation the writer surveyed the general teaching practices and uses of the tape recorder with 130 brass instructors in colleges and universities throughout the United States. The objectives of this survey were:

1. To determine in general the brass teaching techniques used by college instructors.
2. To determine the percentage of teachers generally using the recorder, and to ascertain their reasons for such usage.

#### The Hypotheses

1. Students taught by following a predetermined technique employing the use of the tape recorder would improve significantly in over-all performance over students taught without the use of such equipment.
2. The same students would improve significantly over a control group in the facet of technique.
3. The experimental students would improve significantly over the control students in the area of interpretation.

An additional question analyzed was whether improvement was greater (for over-all performance) in the first or second half of the experimental period.

#### The Procedures of the Study

In order to test the hypotheses of this study, the following procedures and testing devices were used:

1. Twenty San Diego State College brass students were matched and placed in experimental and control groups.

2. Each student had eight weekly lessons with identical assignments.
3. Experimental students had lessons taped.
4. All students spent six hours per week preparing assignments; experimental students devoted seventy minutes of their time in listening to lesson tapes.
5. A recorded performance test was administered three times during experiment.
6. Three judges scored tests.
7. Analysis of means of scores was made; analysis of variance was employed to corroborate the findings.

#### Results and Conclusions

1. No statistically significant differences in improvement between groups were found.
2. Both groups showed highly significant improvement between Pre-Test and Post-Test.
3. There was significantly greater improvement in the latter half of the experimental period.
4. Experimental group students indicated greater improvement during the first half of the experiment.
5. Control students made greater gain in the last half.
6. Control subjects of inferior ability showed slightly greater gain over their matched-pair subjects during the last half of the experiment.

On the basis of the results of this investigation, it was impossible to conclude that the recorder-technique, as used in the study, was more effective than the conventional method of teaching in improving student performance.

1. John R. Miles and Charles R. Spain, Audio-Visual Aids in the Armed Services, American Council on Education, Washington, D.C., 1947, Chapter II.

2. Glenn A. Peterson, "A Study of the Value of the Magnetic Recorder in the Voice Studio," (Unpublished Master's thesis, University of Kansas, 1951).

3. Clair V. Barnard, "The Uses of the Tape Recorder as a Teaching Aid in Instrumental Music," (Unpublished Master's thesis, The Ohio State University, 1956).

4. Frances M. Andrews, "The Development of a Rehearsal Technique for a Secondary School Choral Group Based on the Use of the Magnetic Tape Recording Machine as a Tool for the Choral Director," (Unpublished D.Ed. thesis, Pennsylvania State College, 1948).

Microfilm \$2.50; Xerox \$4.80. 94 pages.



A STUDY OF THEORETICAL WRITINGS  
ON MUSICAL FORM TO CA. 1460.

(L. C. Card No. Mic 60-5645)

Frederick Baron Crane, Ph.D.  
State University of Iowa, 1960

Chairman: Professor Albert T. Luper

The dissertation attempts a comprehensive survey of what was written about formal aspects of music in the Middle Ages. It is a study of as much pertinent material as could be extracted from accessible writings of medieval theorists, beginning with the earliest ones who treat technical aspects of plainsong, and ending with the last writers before the establishment of the Renaissance style.

An introductory chapter discusses the problem of form in music, and provides a working definition for use in determining what early written material can be considered as falling within the scope of the subject. The body of the dissertation is in three chapters, which discuss this material, dividing it according to three main bodies of music with which it is concerned: plainsong and unmeasured polyphony, the secular fixed forms, and measured polyphony in general. A final chapter puts the medieval material into context by summarizing it together with the subsequent history of the theory of form.

Discussion of formal aspects of music by medieval writers is generally quite rare, brief, and only incidental to discussion of other aspects. Nevertheless, taken together, the amount of such material is surprisingly large, and includes observations on music of most medieval styles and periods.

Little development can be observed in medieval theory of form, and even little continuity from one theorist to another, except as an outcome of the authority exerted by a few such writers as Guido of Arezzo and Johannes de Muris.

The phrase structure of a piece of music is the most commonly discussed aspect of form. Some writers, in connection with plainsong, discuss the building of figures out of notes, phrases out of figures, sections out of phrases, and whole works out of sections. The analogy of musical structure to that of language in this respect is often pointed out, and the musical terminology is largely drawn from that of grammar.

Repetition is discussed in various contexts, including the special types of voice interchange and the isorhythmic *color* and *talea*. Although imitation is found nearly as far back as the earliest measured polyphony, and canon is increasingly employed from ca. 1300 on, theoretical discussion of imitation does not begin until near the end of the fifteenth century, when its systematic use becomes established as the chief structural principle in serious music. A dynamic view of musical form is extremely rare, and associated only with plainsong. Except in some common and obvious cases, such as the secular fixed forms, hardly any attention is given to over-all form.

Microfilm \$4.10; Xerox \$14.40. 319 pages.

THE STATUS OF MUSIC IN  
IOWA HIGH SCHOOLS

(L. C. Card No. Mic 60-5672)

Gerald Lee Lawson, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor Neal E. Glenn

The purpose of this study was to determine the status of music in Iowa high schools having an enrollment greater than 100 during the 1959-1960 school year. More specifically, it was to provide information regarding the following questions:

1. What is the pattern of music courses and activities currently being offered in the public senior high schools of Iowa?
2. What items of equipment and teaching aids are available to high school music teachers in Iowa?
3. To what extent are Iowa high school music teachers fulfilling supervisory and instructional functions in music at the elementary and junior high school levels of instruction?
4. To what extent are Iowa high school students participating in music classes and activities?
5. How valuable do music teachers consider their undergraduate preparation with regard to their current high school music teaching assignment?
6. How are Iowa high school music teachers generally regarded by Iowa high school principals and superintendents?

The data presented in this study were collected by questionnaire. Separate sections of the questionnaire were mailed to high school administrators and music teachers in 374 Iowa high school districts. Two hundred sixty-six administrators and 515 music teachers returned usable sections of the questionnaire which were included in the study. To the author's knowledge it was the first statewide investigation of the music program in Iowa high schools.

On the basis of the data presented in the investigation, the following conclusions appeared clearly in the evidence:

1. Music in Iowa high schools was more often curricular than extra-curricular. Most of the music instruction occurred within the school day.
2. Most of the music instruction in Iowa high schools was selective in nature.
3. There was very little evidence that Iowa high schools were adequately providing for the interests of students in the area of general music.
4. Iowa high schools offered very few courses in music on a non-selective basis. Little provision was made for students whose interests were not related to musical performance.
5. Little instruction in the area of strings was offered.
6. Little opportunity was provided students who developed special interests in music which extended beyond the performance ensembles.
7. A high majority of music teachers were teaching music classes at the elementary or junior high school levels of instruction.

8. Nearly 57 (56.88) per cent of all Iowa high school students did not participate in any sort of music activity.
9. Music teachers generally rated their undergraduate preparation highly useful in their high school music teaching assignment.
10. A need exists in Iowa high schools for music teachers who are more aware of the general objectives of the entire high school.
11. A need exists in Iowa high schools for more adequate financial support of the music program.
12. Music teachers in Iowa high schools were generally better prepared and of a higher quality than was true several years ago.
13. The majority of Iowa high school music teachers were trained in the area of music.
14. Iowa High School Music Association sponsored activities were widely participated in by high school music students.
15. Music workshops and/or extension classes were generally regarded to be of high value to Iowa music teachers.
16. A need exists in Iowa high schools for the retention of music teachers for a longer period of time.
17. There is a need for greater participation on the part of music teachers in the Iowa Music Educators Association.
18. The majority of high school music teachers were responsible for either the vocal or instrumental department, but not both.

Microfilm \$2.50; Xerox \$5.80. 116 pages.

#### THE SYMPHONIC INTRODUCTIONS OF JOSEPH HAYDN

(L. C. Card No. Mic 60-5681)

Gail Ellsworth Menk, Ph.D.  
State University of Iowa, 1960

Chairman: Dr. Thomas S. Turner

Although the slow introduction became a common addition to symphonies of the eighteenth and nineteenth centuries, little has been written about its early use and subsequent development. The main part of this thesis is concerned with symphonic introductions of Joseph Haydn, the first recognized great composer to use them in symphonies.

Chapter I discusses available information on the subject of introductions in general, pointing out that such sources, often dated ones, give only a superficial coverage. In none of the standard music references is there a thorough study of the subject, while in a typical analysis of a symphony the author usually dismisses the introduction with a sentence or two, if he mentions it at all.

In Chapter II examples are cited to show that introductions to vocal and instrumental works were used long before Haydn and others used them in symphonies.

The main part of this study is in Chapter III, where, after preliminary considerations, analyses are made of all the Haydn symphonic introductions and conclusions are derived. Although most of them follow similar procedures in phrasing, melody, harmony, and rhythm, no definite

form as such can be assigned to them. Both regular and irregular phrases are found, with a general tendency toward an increase in number and corresponding decrease in length of phrases occurring in the later introductions. Harmonically, they usually consist of two basic divisions of tonic and dominant prolongations. Whereas the first part is usually centered around the tonic, with diatonic harmonies prevailing, the second part usually introduces chromatic harmonies which move to a strong preparation for the dominant, the latter often being extended in the final measures. Modulations become standard practice in the introductions of the Salomon symphonies, but almost always to keys directly related or closely related to the parallel minor mode. Melodically, the Haydn symphonic introductions are usually unified by motives from the initial phrase, new motives seldom appearing in subsequent ones. Unity is frequently maintained through rhythm -- rhythmic motives, and dotted rhythms. In at least thirteen introductions there is probable thematic relation with one or more of the succeeding movements. Whereas in some cases the relation is obvious, in others it is less certain and more open to question. Haydn has made a varied use of dynamics. Usually there is considerable change in dynamics throughout, often involving abrupt and unexpected changes. There is more detailed and complex use of dynamics in the later introductions.

Haydn symphonic introductions differ from the various earlier ones analyzed in Chapter II in that they are usually longer, contain slower harmonic rhythm, and use independent melodies, as opposed to the more chordal ones of the Baroque period.

Chapter IV briefly discusses the general musical character of the Haydn introductions, pointing out that they not only contain material of intrinsic musical worth, but also give promise of something important to follow.

To conclude, the author hopes that this study will provide a point of departure for research into introductions, symphonic and otherwise, by composers from the various periods in music history.

Microfilm \$2.50; Xerox \$6.80. 143 pages.

#### AN EXPLORATORY STUDY OF THE CONTRIBUTIONS OF COLLEGE COURSES TO THE PREPARATION FOR CAREERS IN THE MUSIC INDUSTRY

(L. C. Card No. Mic 60-5398)

John Sutherland Murray, Ed.D.  
University of Oregon, 1960

Adviser: Robert E. Nye

A preliminary study by the author showed that the bulk of occupational information on the music industry was inadequate. For this reason the objectives of this study were:

1. To compile pertinent data on the music industry which may be used by students and advisers.
2. To determine the degree of counselling and advising in the music industry offered in institutions of higher learning.



3. To find the essential courses that may be completed by the music student which will enable him to function more effectively in the music industry.
4. To summarize and analyze the opportunities and salaries available in the music industry to the properly trained music student.
5. To make recommendations for a planned university curriculum which should enable the music student to secure a position in the music industry.

Data were secured by the following methods:

1. A questionnaire was constructed to provide for an appraisal of the strengths and weaknesses of the advisement services in regard to the music industry at schools of music. The questionnaire was distributed to deans and administrative officers of schools and departments of music at two hundred colleges and universities granting a Bachelor of Music degree recognized by the National Association of Schools of Music. Respondents were asked to indicate

- (a) the amount of counselling and advising offered in the field of music industry.
- (b) the sources of information used for counselling and advising.

Replies from one hundred and seventeen, a return of 58.8 per cent, were used in the analysis.

2. A questionnaire, distributed to members of the Music Industry Council, was structured to permit respondents to indicate the employment opportunities and salaries in the music industry and the university courses, skills and other prerequisites considered desirable prior to employment in the music industry. Replies from fifty-nine, a return of 39.3 per cent, were used in the analysis.

The conclusions drawn from the data were:

1. At the present time there is an inadequate supply of current and thorough occupational information on the music industry.
2. Schools of music in institutions of higher learning are not well informed on the music industry.
3. Schools of music in higher institutions are offering little guidance and counselling on the music industry.
4. The job-analysis aspect of vocational guidance on the music industry is neglected.
5. It is desirable that college music students take courses in Business Administration and Music prior to entering the music industry. Courses considered essential are Business English, Fundamentals of Salesmanship, Fundamentals of Promotion, and Introduction to Music and its Literature.
6. It is desirable that college music students have sales experience, teaching experience, and a broad cultural background prior to entering the music industry.
7. Job opportunities in the music industry are enhanced when the college music student has completed the desired courses and training.
8. The Business Administration-Music degrees offered by Bradley University and Indiana University are worthy programs which deserve study.

On the basis of the data gathered and the conclusions drawn from the data, it is recommended that:

1. Occupational information on the music industry be compiled into an easily obtained reference list for the use of university counsellors and advisers.

2. More liaison work be done cooperatively by the music industry and music educators to design an improved music-business course.

3. Schools of music should be encouraged to organize programs of study which would lead to the management of retail music businesses.

4. The National Association of Schools of Music investigate the possibility of a recognized Business Administration-Music degree that could be adopted by its members. The writer recommends that the following courses be an essential part of this recognized degree: Business English, Fundamentals of Salesmanship, Introduction to Music and its Literature, and Fundamentals of Production.

Microfilm \$2.50; Xerox \$7.60. 164 pages.

#### A STUDY OF THE EFFECT OF CHANGES IN VOCAL INTENSITY UPON THE HARMONIC STRUCTURE OF SELECTED SINGING TONES PRODUCED BY FEMALE SINGERS

(L. C. Card No. Mic 60-5325)

David Watters Scott, Mus.D.  
Indiana University, 1960

Director: Dr. E. Ross Ekstrom

The purpose of this investigation was to ascertain what effect changes in vocal intensity made upon the harmonic structure of singing tones produced by ten female singers on vowel sounds *ee*[i], *ah*[a], and *oo*[u] at three intensity levels (+13 db, +5 db, and -3 db). These levels approximated the loudness levels of *ff*, *mf*, and *pp*, respectively, and were produced on pitch level *C*<sup>4</sup> (523 cps).

This study was based upon the primary assumption that there were similarities in the acoustical patterns of singing tones, which allowed for comparisons to be made between the harmonic structures of these tones.

Five specific problems were formulated, the answers to which provided a step-by-step solution to the entire problem. Those specific problems involved the determination and comparison of: (1) The harmonic structures of tones sung by individual singers, and (2) the average harmonic structures of groups of tones of a given type as sung by all singers.

Ten female students studying applied voice in the School of Music at Eastern New Mexico University during the first semester of the 1959-60 academic year produced singing tones at pitch level *C*<sup>4</sup> (523 cps) on vowel sounds *ee*, *ah*, and *oo*, and at the intensity levels of +13 db, +5 db, and -3 db. A total of ninety tones was recorded, consisting of nine tones from each of ten singers. The ninety recorded tones were played individually into a Vibralyzer (sound spectrograph) and an harmonic analysis was obtained for each tone.

The results of the harmonic analyses of these tones, i.e., the strengths of the partials, constituted the data for the study. These data were utilized to: (1) graphically compare the strengths of partials of the tones sung on different vowels and intensity levels; (2) analyze the similarities which existed between the strengths of the partials and between the strengths of the means of partials as tones became less intense; and (3) describe the

similarities which existed between the energy areas (formants) of the tones as they became less intense.

Subject to the limitations of this study, the effect of changes in vocal intensity upon the harmonic structure of singing tones produced by ten female singers on vowel sounds ee, ah, and oo is summarized as follows: (1) As the tones became less intense all partials except the first decreased in strength, with the higher partials disappearing first. The first partial remained constant at all intensity levels. No partials above the eighth partial (4184 cps)

were observed in any of the ninety tones. (2) Each tone was characterized by at least two energy areas at the strongest intensity level. As the tones became less intense both energy regions narrowed (except for the first region on vowel sound ee), and the second energy region decreased in strength and sometimes disappeared. (3) As the tones became less intense the center of the second energy area shifted to a lower partial.

Microfilm \$3.15; Xerox \$11.05. 244 pages.

## PHARMACOLOGY

### SITES OF ACTION OF 1,4-DIPYRROLIDINO-2-BUTYNE, "TREMORINE."

(L. C. Card No. Mic 60-5309)

Alexander Herbert Friedman, Ph.D.  
University of Illinois,  
Chicago Professional Colleges, 1960

Tremorine, 1,4-dipyrrolidino-2-butyne, produces some or all of the following actions in commonly used laboratory animals: tremor, rigidity, asthenia, salivation, lacrimation, urination, defecation, mydriasis, pilomotor activity, bradycardia, hypotension, and hypothermia.

The purpose of this investigation was to localize the sites of these actions, particularly with regard to the autonomic effects. This was accomplished by studying the action of Tremorine on parasympathetically and sympathetically innervated structures of the mouse, rat, cat and dog in both intact and isolated preparations including the submaxillary gland, the nictitating membrane, the urinary bladder, the heart, the pupil of the eye, and the inferior mesenteric ganglion.

It was concluded that Tremorine stimulated or facilitated transmission in the parasympathetic ganglia of the submaxillary gland and the urinary bladder, and the sympathetic ganglia to the nictitating membrane. It both stimulated and inhibited transmission through the cardiac vagal and inferior mesenteric ganglia, whereas it only inhibited the ciliary ganglia. Section of the efferent nerves to the submaxillary, cardiac vagal, and inferior mesenteric ganglia did not prevent the action of Tremorine, whereas the administration of ganglionic blocking agents (TEA and hexamethonium) and a cholinergic blocking agent (atropine) blocked the action of Tremorine. It is therefore concluded that the site of Tremorine's autonomic action is largely peripheral at ganglia, although the possibility of an action in the pre-synaptic region of the postganglionic neuron has not been ruled out.

Tremorine was a weak inhibitor of true and pseudo-cholinesterase *in vitro* approximately 1/1000 to 1/10,000th as active as neostigmine. It is unlikely that this property plays an important role in the autonomic effects of Tremorine. Tremorine produced considerable facilitation of the twitch response of the gastrocnemius muscle to electrical stimulation only when the sciatic nerve was intact suggesting that the site of this action is more central.

The hypothermia produced by the administration of Tremorine increased as the ambient temperature decreased. The "critical temperature" for the production of hyperthermia was above 33° C. The hypothermia was dose dependent, i.e., increasing within certain limits with the increase in dose of Tremorine. The hypothermia might be of central origin, although facilitation of heat loss can be attributed in part to a peripheral action of Tremorine.

Animals adapted to a low environmental temperature (5° C) had significantly less hypothermia after Tremorine than did non-adapted animals. It is therefore inferred that heat production or general metabolism might be altered by Tremorine.

The tremor produced by Tremorine was dose dependent, the "quantity" of tremor increasing with the dose, the onset of tremor decreasing with an increase in dose. The degree of tremor produced by any particular dose of Tremorine was dependent on the ambient temperature, being most pronounced below a neutral environmental temperature, and less above this range of environmental temperature. Tremorine did not produce tremor in mice below the level of spinal transection; this is in agreement with the suggestion of Everett (1956) that the probable site of the origin of Tremorine-induced tremor is central.

Microfilm \$2.50; Xerox \$7.60. 162 pages.

### INTERMEDIARY METABOLISM OF THE HEART AS AFFECTED BY DIGOXIN

(L. C. Card No. Mic 60-5311)

Gerald Alan Kien, Ph.D.  
University of Illinois,  
Chicago Professional Colleges, 1960

Experiments were designed to correlate the cardiac hemodynamic action of a therapeutic dose level (0.065 mg. per kg. body weight) of digoxin to alterations in the kinetics of the intermediary metabolic pathways involved in the myocardial metabolism of glucose-C<sup>14</sup> in the normal dog.

Following administration of digoxin, it was observed that 1) the glucose metabolism of the myocardium was increased (60 percent), 2) the carbon dioxide-C<sup>14</sup> production



of the myocardium was increased (250 percent), 3) the total contribution of glucose to the metabolism of the heart was increased (from 8 percent in the control to 23 percent after administration of digoxin), 4) there was an increase in the turnover rates of the intermediates of the glycolytic pathway (13-fold), the tricarboxylic acid cycle (13-fold), glutamic acid (10-fold) and aspartic acid (10-fold) and, 5) the total activity of an alternative metabolic product of glucose, glucosamine, was decreased.

These metabolic changes occurred in the absence of changes in the dynamics of the heart, indicating that these metabolic alterations were due to a primary effect of the drug rather than an action secondary to an altered state of cardiac activity.

On the basis of this investigation it is concluded that this cardiac glycoside exerts its therapeutic effect on the myocardium by augmenting the metabolic rate of the heart, and hence, the energy production for utilization by the contractile mechanism.

Microfilm \$2.50; Xerox \$6.20. 126 pages.

#### SEX DIFFERENCES IN THE ELECTROLYTE CONTENT OF THE CANINE HEART

(L. C. Card No. Mic 60-5195)

Joseph Roque Emmanuel Valadares, Ph.D.  
The University of Oklahoma, 1960

Major Professor: Paul W. Smith

It has previously been shown that there exists a sex difference in the response of dogs to a toxic dose of digoxin. The objective of this investigation was to study the underlying causes that contribute to this differential response by male and female dogs.

Ventricular muscle from six normal female, six normal male, six spayed female and six estrogen-treated, spayed female dogs was analysed for sodium, potassium, calcium, magnesium, total phosphorus and trichloroacetic acid-extractable phosphorus by improved chemical methods.

The findings of this study may be summarized as follows:

The average cardiac content of sodium, potassium and magnesium was found not to vary significantly in these four types of animals.

Total and acid-soluble phosphorus were found to be highest in the hearts of normal females. The acid-soluble phosphorus/total phosphorus (AP/TP) ratio was highest in the normal female and lowest in the male. Estrogen treatment of the castrate female did not restore the phosphorus distribution to that of the normal female.

The lowest calcium values were found in the hearts of normal females. Calcium values were found to be highest, and almost identical in the hearts of male and castrate female animals. Estrogen treatment (17  $\beta$ -estradiol, 0.5 mg/kg/day for 7 days) lowered the calcium content of the heart of the castrate female to a value which approached but did not equal that of the normal female.

Two major differences in electrolyte content of the heart have, therefore, been found to exist in the four types

of animals studied. Of these, the higher calcium values in the male and castrate female would appear most likely to explain their greater susceptibility to the arrhythmic action of a toxic dose of a digitalis glycoside.

Microfilm \$2.50; Xerox \$3.00. 47 pages.

#### THE PHARMACOLOGY OF SOME 8-SUBSTITUTED PURINE AND XANTHINE DERIVATIVES WITH SPECIAL EMPHASIS ON THE HALOGENATED DERIVATIVES OF THEOPHYLLINE

(L. C. Card No. Mic 60-4934)

Arthur Wolpert, Ph.D.  
University of Maryland, 1959

Supervisor: John C. Krantz, Jr., Ph.D.

The history of hypertension is briefly reviewed. The physiology of blood pressure regulation, the pathogenesis, effects and management of hypertension are also discussed.

Acute intravenous and intrainestinal experiments were conducted with a series of newly synthesized, 8-substituted adenine, caffeine and theophylline derivatives to determine their efficacy in relieving hypertension. The drugs were solubilized and given intravenously and intrainestinally at 20 mg./Kg. and 40 mg./Kg. respectively. Those compounds which reduced blood pressure in anesthetized dogs by both routes of administration were given by stomach tube to trained unanesthetized dogs at dosage levels of 40 mg./Kg. Arterial blood pressures were taken by direct femoral puncture 1, 2 and 3 hours after the drug. None of the compounds elicited a fall in blood pressure in the unanesthetized dogs. The compounds do not appear to be readily absorbed.

Further pharmacologic studies were conducted with the 8-halogenated theophylline derivatives. The 8-fluoro derivative of theophylline could not be obtained and in its place 8-trifluoromethyltheophylline (TRF) was used. Theophylline was employed as a comparative standard against TRF, the bromo, chloro, and iodo derivatives of theophylline.

Blood levels of the theophylline derivatives were determined spectrophotometrically after intravenous administration to anesthetized dogs at dosage levels of 20 mg./Kg. and 50 mg./Kg. The peak blood level concentration appears 10-20 minutes after administration. All the derivatives exhibit a uniform rate of degradation over a 1 hour period. No correlation could be drawn between blood levels of the compounds and their activity on the blood pressure.

Diuretic studies conducted on rats indicate that all the theophylline derivatives are more potent diuretics than the parent compound. The iodo derivative is the most active diuretic of the series. Blood level measurements conducted simultaneously have shown that diuretic activity could be closely correlated with changes in the blood concentrations of the compounds over a 5 hour period.

Peripheral blood flow was measured with a bubble flowmeter attached to the femoral artery of anesthetized dogs. Simultaneous blood pressure measurements were

used to determine peripheral resistance. Theophylline is most active in reducing peripheral resistance after intra-arterial injections in doses of 0.1-4.0 mg. As the test dose is increased, activity relationships of the series varies; however, at the highest dose all the derivatives attain an activity which is approximately 60% of that of theophylline.

The compounds were tested for coronary artery vasodilatation using the isolated rabbit heart with a modified

Langendorff technique. To determine bronchiolar and tracheal smooth muscle activity, the isolated guinea pig lung and the histamine stimulated guinea pig tracheal chain were used. With these preparations theophylline was more active than any of its halogenated derivatives in producing coronary artery dilatation and smooth muscle relaxation. This relationship was also true of its activity with the frog heart and isolated guinea pig ileum.

Microfilm \$2.50; Xerox \$6.00. 124 pages.

## PHILOSOPHY

SPACE, TIME AND SUBSTANCE:  
A PHILOSOPHICAL INQUIRY.

(L. C. Card No. Mic 60-5594)

Frederick Irwin Dretske, Ph.D.  
University of Minnesota, 1960

The purpose of this thesis is to critically assess, with respect to a specified set of criteria, various philosophical views concerning the nature of space and time as these views are affected by and related to the sort of entities one takes as basic in the spatio-temporal scheme. Aside from the more or less combinatorial questions concerning which elements are mutually necessary and sufficient to give complete and consistent expression to our knowledge claims about space and time, emphasis is placed upon the epistemological requirements embodied in modern empiricism in evaluating these theories, and the examination is confined to those views which are formulated with attention to these demands.

The inquiry is broken up into several parts, classified according to the sort of particular or basic existent which a given theory adopts. The first cluster of views examined are those, inspired by common-sense and forms of philosophical realism, which are dedicated to the view that continuants are the basic individuals in space and time. Several alleged proofs for the necessity of continuants are found to be inconclusive. Aside from the indispensability of tensed predication, something in the nature of events or event-like particulars are required, in addition to continuants, to make such a framework descriptively complete. Once this is admitted, the question is open whether continuants are needed at all. Some epistemological difficulties are then discussed with a brief suggestion made concerning a possible way to avoid them.

A conceptual scheme involving unchanging particulars, usually taken as "fleeting" sense data, is discussed next with some of its criticisms regarding change and spatial position answered by a sample translation into the proposed idiom. After an examination of this theory's treatment of tenses, the criticism is raised that such a view fails to make its account of time fully explicit by suppressing the role which events play in the delineation of its particulars. These events, unlike a prevalent use of the term which takes events as short-lived particulars, are complex items involving an entity having a property or standing in a relation. The recommendation is made

that for a fully explicit account of time, events should be recognized as the ultimate elements constitutive of the temporal order.

Theories by Bertrand Russell, A. N. Whitehead, and C. D. Broad are also examined. Russell's attempt to eliminate particulars altogether in favor of qualities and their interrelations is found to be defective; once again it is complexes, indistinguishable from events, which provide the basis for time within Russell's system. It is argued that Whitehead's position, except for terminology and emphasis, is enough like the theory dealing with unchanging particulars to be open to the same criticisms. Broad's attempt to utilize processes alone as the sole constituents in space and time is criticised for its failure to give a proper account of space.

Finally, a proposal is made for the inclusion of events in a systematic treatment of space and time as a kind of particular. The difficulties to such a procedure are explored along with the advantages which accrue to such a system. The claim is advanced that any system must ultimately recognize complex elements like events as the fundamental entities in time. This may be manifested in many ways, but in any case it effects a fundamental separation between the ingredients of the spatial and the temporal orders.

Microfilm \$4.10; Xerox \$14.40. 320 pages.

HERBERT BUTTERFIELD: THE EPISTEMOLOGY  
OF A WORKING HISTORIAN.

(L. C. Card No. Mic 60-5596)

Owen Warner Dukelow, Ph.D.  
University of Minnesota, 1960

The philosopher of history ought to acquaint himself with history as understood by the practicing historian. Herbert Butterfield, Professor of Modern History at Cambridge University, is a conscientious historian. He has written extensively both history and critiques of historiography.

History as a discipline is limited by the nature of its evidences. They are material, but the interest of the



historian includes mental acts. The historian may draw only conclusions justified by his evidences. Historical events are not distinguished from other sorts of events by being unique. In a certain respect every event is unique. To avoid the problem of uniqueness one may abstract from events certain elements they hold in common. The historian by his interest in the whole of the event is left with the uniqueness of the event.

The historian can fall into erroneous history by ignoring his limitations or failing to include all in his narration that his discipline will allow.

Whig history is reading history with too much of an eye on the present. The interpretation of history is brought in at the start of the study and the facts of history are forced into the form of this interpretation. History is abridged by a rule of thumb whereby it is made to teach the lesson that the historian has brought from some source other than history.

The opposite form of faulty history is history that is too scientific. This history confining itself to the tangible aspects of human past eliminates the untangibles such as mental acts, thereby eliminating a part of past human action.

In contrast Professor Butterfield presents what he calls academic history. This takes into account the limitations which the evidences place upon the historian, but does not sacrifice his interest in as much of past human drama as is reproducible on the basis of surviving evidences.

Interpretations of history are not eliminated but they are extra-historical. They enter only when the historian has by his discipline reconstructed the past. Only at that point is there anything to be interpreted. Historical interpretations are the postures we take to the past and are not given by history. Historical explanation is not to be distinguished from historical narration. The historian does not have an historical sort of subject that needs explaining. Rather that which is to be explained historically is surrounded by a web of understanding, that is, by narrating the conditioning circumstances in greatest detail.

Microfilm \$2.50; Xerox \$8.60. 190 pages.

#### THE ETHICAL DEVELOPMENT OF MANAGERIAL RESPONSIBILITY

(L. C. Card No. Mic 60-5090)

Samuel E. Gluck, Ph.D.  
Columbia University, 1960

Power, authority, and responsibility, are problems for social philosophy in the classical sense. "Group responsibility" refers to the obligations that accrue to any group because it is a group; i.e., all groups have, or strive for, power to accomplish goals, and this group power carries certain responsibilities. Although "Management" and "Labor" are not the only powerful groups in society, in an industrial society they are the two groups making the most frequent and pressing demands upon each other and upon others in the society. Today, "management's social responsibility" is a major preoccupation of the professional managerial group. This present study briefly

reviews the general philosophical orientation of management, by analyzing the philosophical views taught in American collegiate schools of business. A questionnaire was sent to 150 departments of business education, and the most-frequently-required texts were analyzed philosophically. These included texts in "human relations," "personnel management," "public relations," "decision making," and general management principles; as well as texts devoted wholly to "business ethics" or "responsibility." Chapter III, "'Science' and 'Professionalism' come to Management," deals with scientific management, the human-relations school, and the ethical dilemmas of business professionalism. Chapter IV, "Some Problems in the Responsibility Curriculum," analyzes the ethical isolation -- and isolationism -- of "business ethics," and the transactionalist approach to ethical problems; and pays special attention to the work of Peter Drucker.

The following conclusions are reached. First, management fails to see that its societal problems, though of different species, are of the genus group responsibility. As a result, management has come to believe that its ethical problems are of a special kind capable of generalized and permanent concrete solution via "policy decisions"; and not only divorced from but actually hampered by the "vague generalities of philosophical ethics." This conviction isolates the decision-making manager from all general theories about social values. Secondly, in both management texts and critical treatises, social responsibility is defined in terms of conformity to the mores of the society in which the businessman (manager) is operating. This philosophically truncates managerial thinking just below the level where philosophical decisions must be made, because it eschews management's role in the guiding of social change and totally ignores the classical content of social philosophy; namely, the logical and empirical justification of theories of society or systems of authority, and the warrant for the assumptions underlying choices between alternative systems. Third, there is the analogous fallacy (arising out of this isolation from general valuational criteria), of reducing ethics to psychology. This is a common conceptual failing of management, and dominates scientific management and both the Mayo and Drucker schools. These failings combine to decrease management's ability to cope with social change.

The concluding chapter sketches a method, that of ethical politics, for replacing group individualism by responsible individuality. Group individualism is currently dominant--powerful groups act as if they were society's individuals. Responsible individuality may still involve intense competition and disagreement, but the method of ethical politics seeks conflict resolution in terms of mutual growth, not total victory or defeat. (The strengths and weaknesses of theories of functional pluralism are discussed in terms of ethical politics). Ethical politics is both an educative and reconstructive process, and must be empirically grounded as well as concept-oriented and logically constructed. It is thus a socio-philosophical method; and its suggested starting point --societal and philosophical-- is the concept of social cost and the related but much more difficult problem of creating social profits. To explicate these concepts is part of the "group responsibility" of philosophers.

Microfilm \$3.40; Xerox \$11.95. 261 pages.

## PHYSICS

### PHYSICS, GENERAL

#### FORMAL TECHNIQUES IN THE LAMB SHIFT CALCULATION

(L. C. Card No. Mic 60-5597)

Glen Walter Erickson, Ph.D.  
University of Minnesota, 1960

Adviser: Donald R. Yennie

The shift of one-electron atomic energy levels due to the interaction of the electron with the quantized radiation field is calculated. A formal expression for the one-photon self-energy term is rederived, using more elementary methods. Techniques are then introduced which permit systematic calculations of all orders up to  $\alpha(Z\alpha)^6 mc^2$ . Calculations are made of the lowest orders,  $\alpha(Z\alpha)^4 mc^2 \log Z\alpha$  and  $\alpha(Z\alpha)^4 mc^2$ , and the higher order,  $\alpha(Z\alpha)^6 mc^2 \log^2 Z\alpha$ , providing an independent check of current results of other workers. Terms of order  $\alpha(Z\alpha)^5 mc^2$  and  $\alpha(Z\alpha)^6 mc^2 \log Z\alpha$  are located. The calculation has the features that gauge invariance is retained to a later stage and both the lower and higher order terms are presented in a fairly compact form.

Microfilm \$2.50; Xerox \$4.40. 81 pages.

#### GRAVITATIONAL RADIATION DAMPING

(L. C. Card No. Mic 60-4838)

John Leonard Ging, Ph.D.  
The University of North Carolina, 1960

Supervisor: Dr. Bryce S. DeWitt

The equations of motion of an uncharged particle in a gravitational field are derived from the field equations of general relativity up to the approximation which includes the first effects of radiation reaction.

Microfilm \$2.50; Xerox \$3.00. 33 pages.

#### ENERGY AND ANGULAR DISTRIBUTION OF SECONDARY ELECTRONS PRODUCED BY 50-100 KEV PROTONS IN HYDROGEN GAS

(L. C. Card No. Mic 60-5575)

Chris Ernie Earl Kuyatt, Ph.D.  
The University of Nebraska, 1960

Adviser: Theodore Jorgensen, Jr.

Hydrogen gas in a rotatable scattering chamber was bombarded by 50, 75 and 100 keV protons from the Ne-

braska Cockcroft-Walton accelerator. The resulting secondary electrons were analyzed in both direction and energy by a slit system and a cylindrical electrostatic analyzer and counted by an electron multiplier tube with suitable electronics. Relative values of the differential cross sections were measured for 0.2 to 300 ev electrons at angles of  $23^\circ$ ,  $45^\circ$ ,  $67\frac{1}{2}^\circ$ ,  $90^\circ$ ,  $112\frac{1}{2}^\circ$ ,  $135^\circ$  and  $152^\circ$  from the proton beam direction. As a function of electron energy, at a fixed angle, the differential cross section shows a broad peak at 4 to 9 ev with a monotonic decrease at higher electron energies. As a function of angle, for fixed electron energy, the differential cross sections are largest at  $23^\circ$ , dropping off rapidly until  $90^\circ$ , then becoming relatively constant. Agreement with the results of Blauth at  $54.5^\circ$  is good for electrons from 8 to 100 ev and poor outside this range. Calculations made using the Born approximation are in very poor agreement with the experimental results. Extrapolation and integration of the results over all angles gives an energy distribution which is in poor agreement with the calculation of Bates and Griffing. Further integration over all electron energies gives relative total ionization cross sections which are not inconsistent with the measured values of Schwirzke.

Microfilm \$2.50; Xerox \$6.60. 137 pages.

#### THE DEVELOPMENT OF A CORPUSCULAR RADIATION EXPERIMENT FOR AN EARTH SATELLITE

(L. C. Card No. Mic 60-5679)

George Harry Ludwig, Ph.D.  
State University of Iowa, 1960

Co-Chairmen: Professor Lawrence A. Ware  
Professor James A. Van Allen

The satellite S-46 payload system was developed to study the belts of high intensity radiation surrounding the earth. In particular, it was designed to monitor the spatial and temporal intensity structure to a radial distance of about seven earth radii and for a one year period, to permit a crude study of particle composition and energy spectra, and to provide the first exploratory study of the very low energy component of the trapped radiation. The payload consisted of five detectors and their high voltage power supplies, electronic circuits to count and encode their outputs, a telemetry system, and a solar and chemical battery power system. The factors influencing the selection of the payload configuration and the satellite orbit are discussed, and a detailed description of the instrumentation is included.

The satellite launch attempt on 23 March 1960 failed due to improper functioning of the second, third, and fourth stage rocket assembly. Operation of the instrumentation during the nine minute launch trajectory was, however,

1969

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completely satisfactory. The detectors and electronics system are still believed capable of fulfilling the initial objectives, and a new set of instruments utilizing similar detectors is being prepared for flight in another satellite-launch vehicle configuration in 1961.

Microfilm \$4.15; Xerox \$14.65. 324 pages.

#### DIFFUSION OF SILVER AND GOLD TRACERS IN SILVER-GOLD ALLOYS

(L. C. Card No. Mic 60-4847)

William Cannon Mallard, Ph.D.  
The University of North Carolina, 1960

Supervisor: L. M. Slifkin

The diffusion of  $\text{Ag}^{110}$  and  $\text{Au}^{198}$  tracers in single and coarse-grained polycrystalline silver-gold alloys was studied. The temperature dependence of the diffusion coefficients in the range  $650^\circ$  to  $960^\circ\text{C}$  for silver diffusion was determined in 8, 16, 34, 50 and 66 atomic percent gold silver-gold alloys. The corresponding gold tracer measurements were made in 8, 16, and 34 atomic percent gold alloys in the temperature range between  $720^\circ$  and  $950^\circ\text{C}$ . For each concentration the diffusion coefficient obeyed an equation of the form  $D = D_0 \exp(-Q/RT)$  with a constant activation energy,  $Q$ , and frequency factor,  $D_0$ .

Combining the silver tracer results with silver self-diffusion measurements by Tomizuka and Sonder and Bass's data on silver diffusion in 84 atomic percent gold-silver alloys, the concentration dependence of the silver diffusion coefficient at a given temperature was found to pass through a minimum. This minimum shifted from approximately 50 atomic percent gold at a temperature of  $950^\circ\text{C}$  to approximately 30 atomic percent gold at  $650^\circ\text{C}$ .

The gold diffusion coefficient decreased with increasing gold concentration in the range studied but at a slower rate than the corresponding changes for the silver tracer. Extrapolating these results to Makin, Rowe and LeClaire's data on gold self-diffusion indicate a shallow minimum should be observed in the range of 50 atomic percent gold. The concentration dependence extrapolates to Jaumot and Sawatzky's results for gold diffusion in silver only for high temperatures. The discrepancy at lower temperatures can be explained by the presence of a fast diffusing, long half life impurity in the gold tracer electroplated on their silver specimens. To preclude the possibility of tracer impurities, a chemical displacement technique was used for the gold tracer measurements reported here.

The activation energy for both silver and gold tracer diffusion decreased with increasing gold concentration. The difference in these energies also decreased with gold concentration and appeared to have a minimum in the range of 40 atomic percent gold where the solid solution has the greatest departure from ideality. The position of the minimum is not well defined because of the limited amount of gold data presently available.

The frequency factor  $D_0$  for both silver and gold tracers decreases with gold concentration. There is fair agreement between the value obtained for silver self-diffusion and the extrapolation to zero gold concentration, but the corresponding gold data are in poor agreement

with published frequency factor for gold diffusion in silver.

The  $D_0$  observed for gold diffusion is greater than the value for silver tracers, which is contrary to the values expected on a rate theory model. Also, it is surprising that the addition to the solid solution of the component with a higher activation energy (gold) actually decreases the activation energies for diffusion of both constituents.

Microfilm \$2.50; Xerox \$4.40. 82 pages.

#### CROSS-SECTIONS FOR THE EXCITATION OF THE METASTABLE 2S STATE OF ATOMIC HYDROGEN

(L. C. Card No. Mic 60-5108)

Sheldon Schultz, Ph.D.  
Columbia University, 1960

The function for excitation of the 2S state of atomic hydrogen by electron impact has been measured from threshold to 45 ev by an atomic beam method. The absolute value of the total cross section has been determined by two independent methods which are in agreement. In one method the excitation function was normalized to the Born approximation at the higher energies. The mechanism of cascade from higher p states was found to play a significant role in population of the metastable 2S level. The other method proceeded by determining the metastable detection efficiency in terms of the known efficiency for Lyman- $\alpha$  photons. The yield for ejection of electrons from an untreated platinum surface by  $\text{H}(2\text{S})$  is  $0.065 \pm 0.025$ . The total cross section reaches a maximum value of  $(0.35 \pm 0.05)\pi a_0^2$  at 11.7 ev. The exchange cross section was also measured by the atomic beam method. The incident atoms were polarized in a Stern-Gerlach experiment; the metastable atoms were analyzed by the selective quenching action of a magnetic field of 575 gauss. The ratio of the exchange to total cross section is  $0.45 \pm 0.05$  near threshold. At higher energies, this ratio approaches zero.

The cross section for production of metastable atoms by direct bombardment of molecular hydrogen is  $0.03\pi a_0^2$ . This value is considered correct to within a factor of two.

Microfilm \$2.50; Xerox \$4.60. 87 pages.

#### THE EFFECT OF STRAIN APPLIED DURING DRYING ON THE MECHANICAL BEHAVIOR OF PAPER

(L. C. Card No. Mic 60-6654)

John Hampshire Schulz, Ph.D.  
The Institute of Paper Chemistry,  
affiliated with Lawrence College, 1961

This study is concerned with the effect of mechanical straining of incompletely dried paper on the properties of the fully-dried sheet. Newly-formed wet handsheets at 36% solids were elongated and maintained at constant elongation until completely dry. The process of applying

the elongation is termed "wet straining." The degree of wet straining (DWS) is defined as the amount of elongation divided by the original sheet length, expressed as a percentage. A softwood alpha pulp, beaten to four different freenesses, was used in the study.

The purpose of the investigation was to examine the mechanical behavior of wet-strained paper. The Instron load-elongation tester and the tensile creep test were used for this purpose.

Increased wet straining generally caused the tensile strength of the handsheets to rise, pass through a maximum, and then drop, although a continuous rise in the strength of the most highly beaten pulp was noted. The two least beaten pulps exhibited marked reductions in ultimate elongation and work-to-rupture. A rise in work-to-rupture was noted in the case of one of the pulps as the DWS was increased, although this pulp showed little change in ultimate elongation.

No change in zero-span tensile strength in the direction of wet straining was noted. This was interpreted to indicate that wet straining does not create changes in the distribution of fiber orientations in the sheet.

The bonding characteristics of the handsheets were examined with the transverse tensile strength test, and with optical light-scattering techniques. It was found that wet straining brought about a reduction in the transverse tensile strength. This reduction was least for the most highly beaten pulp. It was found that the light-scattering coefficient of the pulps increased as the DWS was increased, indicating a lessening of the optical contact between the fibers. It is not likely that the decreased bonding is related to the breaking of bonds between the fibers during the wet-straining operation, because of the low solids content at which wet straining occurred.

Tensile creep tests are used to determine the elongation-time relationship for a specimen supporting a load. The first time a specimen is subjected to such a test is called the first-creep test. The recovery of the specimen from the first creep is called the first-recovery test.

Total first creep, at a constant apparent initial stress, during a given time interval, was found to drop and pass through a minimum as the degree of wet straining was increased. The same behavior was observed in the response of mechanically conditioned paper, indicative of a change in capacity for creep by reversible mechanisms. Recovery from first creep was found to be strongly dependent upon the degree of wet straining.

As the degree of wet straining was increased, the elastic modulus rose and passed through a maximum, except in the case of the most beaten pulp, in which case the elastic modulus rose continuously.

A unique relationship was found to exist between total first creep and total first recovery for equal periods of creep and recovery. This behavior was independent of time, stress, and DWS, and was not strongly affected by beating. The existence of this relationship suggests that wet straining does not affect the capacity of paper for nonrecoverable deformation.

It is suggested that wet straining affects the structure of paper, so that changes are produced in the distribution of stress in the sheet when the sheet supports a load. Many of the effects observed are apparently related to a more uniform distribution of stress among the fibrous elements of the sheet, so that more fibrous elements are effective in supporting a load. The more uniform distri-

bution increases the tensile strength, decreases the response to stress, and increases the elastic modulus. Such a change in stress distribution could occur if wet straining created a reorganization of the components of the sheet, and might involve the straightening of the fibrous elements between points of bonding.

Microfilm \$2.50; Xerox \$7.60. 164 pages.

## DISLOCATION NETWORKS AND VACANCIES IN IONIC CRYSTALS

(L. C. Card No. Mic 60-5193)

William Arthur Sibley, Ph.D.  
The University of Oklahoma, 1960

Major Professor: Colin A. Plint

Light scattering in single crystals of potassium chloride grown by the Harshaw Chemical Company and the U. S. Naval Research Laboratory was measured for different wavelengths and scattering angles and for different orientations of the crystal with respect to the incident light beam. It was found that the scattering system in Harshaw crystals has fourfold axes of rotation parallel to the  $\langle 100 \rangle$  directions of the crystal, and a partial Fourier analysis of the scattering power indicates that the scattering is mainly produced by networks of dislocations, composed of individual dislocation lying along the  $\langle 100 \rangle$  directions of the crystal. The dislocations have a width of about 200A and an estimate of their length and the number of vacancies surrounding the dislocation is made. The crystals grown by NRL exhibit no orientational dependence of the light scattering and the scattering centers are most probably spherical precipitates of diameter 1500A.

By the application of heat treatments or plastic deformation it is possible to investigate the interactions between: (a) vacancies and dislocation lines, (b) vacancies and impurity ions, and (c) edge and screw dislocations. A dissociation energy of .5 e.v. has been found for a positive ion vacancy-calcium ion complex in potassium chloride. The binding energy of a vacancy to a dislocation line can only be estimated from the available experimental data.

Edge and screw dislocation in alkali halide crystals are revealed by chemical etching of the crystal surface. This method was used to find the density of dislocations in the crystals and to investigate the motion of dislocations under various types of heat treatments. The movement of dislocations into small-angle grain boundaries during annealing was observed by etching techniques.

Microfilm \$2.50; Xerox \$5.40. 110 pages.



DISPERSION OF ULTRASOUND IN  
ETHANES, ETHYLENE, AND METHANES.

(L. C. Card No. Mic 60-4907)

Leonard Maurice Valley, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: Sam Legvold

High frequency sound may be used to study the heat capacity lag in gases. The heat capacity, neglecting the electronic part, is ordinarily made up of contributions from translational, rotational, and vibrational degrees of freedom. But, as the frequency, of the sound wave traveling through the gas, is increased the heat capacity lags. The vibrational contribution is the first to lag because of the slow rate of energy transfer between vibrational and translational degrees of freedom. The sound wave sees this decrease in heat capacity and as a result an increase in the velocity of sound (dispersion) is observed. The velocity of sound in a gas is measured with a variable path-length acoustic interferometer.

In this work,  $\text{CH}_3\text{CH}_2\text{Cl}$ ,  $\text{CH}_3\text{CHF}_2$ ,  $\text{CH}_3\text{CClF}_2$ ,  $\text{CClF}_2\text{CClF}_2$ , and  $\text{C}_2\text{H}_6$  were investigated first.  $\text{C}_2\text{H}_6$  exhibited double dispersion and the other gases exhibited single dispersion. It was found that the lowest "regular" mode of vibration should be considered as the exchange mode for the ethane derivatives instead of the hindered rotation mode which was lower in frequency. It is believed that double dispersion appears in ethane because of the big gap in frequency between the mode of hindered rotation and the lowest mode of regular vibration.

An ideal velocity equation for the case of double dispersion was derived and used to find the two relaxation times for  $\text{C}_2\text{H}_6$ . Then various mixtures of  $\text{C}_2\text{H}_6$  and  $\text{C}_2\text{H}_4$  were investigated and again double dispersion was observed. The double dispersion velocity equation was used to determine the relaxation times for the mixtures. The second step in the dispersion curves was always the result of the lagging of the heat capacity of the hindered mode of rotation in ethane. The first step results from the lagging of the rest of the vibrational heat capacity.

It was found that ethane-ethylene collisions are more effective in the transfer of energy from vibrational to translational degrees of freedom than ethane-ethane or ethylene-ethylene collisions. In fact, for the transfer of energy from the mode of hindered rotation in ethane, an ethane-ethylene collision will be 3 to 4 times more effective than an ethane-ethane collision.

An equation relating the relaxation time of a mixture to the pure component relaxation times was derived. The equation was tested against the experimental results for  $\text{C}_2\text{H}_6 - \text{C}_2\text{H}_4$  mixtures and was also tested against experimental results reported by others. The equation proved to be very good.

Microfilm \$2.50; Xerox \$4.80. 95 pages.

ON THE MEASURABILITY OF  
GRAVITATIONAL FIELD STRENGTHS

(L. C. Card No. Mic 60-4876)

Hsin Yang Yeh, Ph.D.

The University of North Carolina, 1960

Supervisor: Bryce S. DeWitt

The purpose of the present work is to study whether limitations on the measurement of the quantized gravitational field strengths, i.e., the quantized Riemann tensors, agree with those determined by physically possible measurements so as to give a proof of the necessity of quantizing gravitational fields. The quantized gravitational field strengths are divided into two types: the electric-type components and the magnetic-type components. In the linearized theory of quantized general relativity, the commutation relation of two field components at two space-time points is a c-number containing the universal gravitational constant, Planck's constant, and the velocity of light. On the passage from classical theory to quantum theory, one also needs to take an average value of a field strength over a space-time region instead of regarding it as a point function. This is true for a magnetic-type component because one has to take an ordinary average of it in the usual sense, while for an electric-type component it has been found that one has to take a weighted average over a space-time region instead of an ordinary average.

The uncertainty of an electric-type component can be obtained by comparing the product of the uncertainties of two field averages stemming from the commutator with the uncertainties obtained from the solution of the field equation. It has been found to be proportional to the uncertainty of a strain and hence it agrees with the uncertainty relation obtained from the dynamical equation of motion of a properly chosen test body which comes from the equation of geodesic deviation. For magnetic-type components Papapetrou's equation for a spinning particle being chosen as a dynamical equation of motion for a test body, a similar agreement as in the case of the electric-type components can also be shown.

The self-reactions of these test bodies during a measurement time interval can be compensated for by introducing appropriate spring mechanisms as Bohr and Rosenfeld did in the measurement of the electromagnetic field strengths. The agreement between the quantum gravitational formalism and the measurabilities of these test bodies is thus really attained. The case in which three respective principal axes of two cubical test bodies are parallel to each other is also extended to the case in which they are not parallel.

Microfilm \$2.50; Xerox \$4.80. 92 pages.

# RESONANT ELECTRON CAPTURE AND MULTIPLE ELECTRON STRIPPING IN MODERATELY LARGE-ANGLE ATOMIC COLLISIONS

(L. C. Card No. Mic 60-5265)

Francis Paul Ziemba, Ph.D.  
The University of Connecticut, 1960

Differential scattering of ions by atoms in the energy range of 1 kev to 200 kev has been studied. The incident ion, after a single collision which is hard enough to result in a  $5^\circ$  deflection, was analyzed to determine whether it had captured or lost electrons. The angle  $5^\circ$  was chosen as a typical moderately large-angle and held fixed as the energy of the incident ion was varied. When the electron capture probability is plotted vs energy, one or more peaks are observed. For the symmetrical case of  $\text{He}^+$  on He, seven peaks are clearly outlined. Four peaks appear in the  $\text{H}^+$  on He combination and three with  $\text{H}^+$  on  $\text{H}_2$ . Single or double peaks are found in other cases studied which include  $\text{H}^+$  on  $\text{N}_2$ ,  $\text{O}_2$ , Air, Ne, Ar, and Kr;  $\text{H}_2^+$  on  $\text{H}_2$  and He;  $\text{H}_3^+$  on  $\text{H}_2$  and He;  $\text{He}^+$  on Ne, Ar, and Kr;  $\text{N}^+$  on Ar;  $\text{N}_2^+$  on  $\text{N}_2$ ;  $\text{Ne}^+$  on Ne and Ar;  $\text{Ne}^{++}$  on Ne and Ar;  $\text{Ar}^+$  on Ar; and  $\text{Kr}^+$  on Kr. For each case the probabilities for electron capture, scattering without change of charge, and various degrees of electron stripping are plotted vs energy. In those cases in which the electron capture probability curve has more than two peaks, these peaks are nearly evenly spaced when the probabilities are plotted vs the time of the interaction. This indicates an electron exchange effect whose period is of the order of  $10^{-16}$  seconds. In cases where there are many electrons involved in the colliding atoms the phenomenon is more complicated, but vestiges of this resonant exchange are sometimes observed.

Microfilm \$2.50; Xerox \$3.00. 47 pages.

## PHYSICS, ELECTRONICS AND ELECTRICITY

### LOW FREQUENCY RADIO STUDIES OF APPARENT IONOSPHERIC MOTIONS

(L. C. Card No. Mic 60-5457)

Gary S. Sales, Ph.D.  
The Pennsylvania State University, 1960

An investigation of ionospheric motions using low frequency radio waves is described. This work presents the experimental results of this program and the development of a theory for the explanation of these observations.

The experimental apparatus and the method of analysis used to obtain values of drift and random velocities are discussed in detail.

A study is made of the sampling errors associated with the computation of correlation coefficients and this work is then applied to specific problems associated with the analysis of motions in the ionosphere.

The results are presented and estimates of the accu-

racy are given for the quantities analyzed. Finally a theory developed in terms of hydrodynamic waves in the ionosphere, to explain the observations of this work and the work of other investigators using medium frequency radio waves.

Suggestions for future studies are made.

Microfilm \$2.80; Xerox \$9.70. 214 pages.

### INSTRUMENTATION FOR THE AUTOMATIC MEASUREMENT OF CHANGES IN PHASE HEIGHT AND AMPLITUDE OF PULSED RADIO SIGNALS INCLUDING PRELIMINARY DATA ANALYSIS

(L. C. Card No. Mic 60-5458)

Walter Sawchuk, Ph.D.  
The Pennsylvania State University, 1960

The experimental purpose of this thesis problem was to increase the sensitivity of phase instrumentation used in pulsed low frequency ionospheric sounding experiments. This was achieved by designing a new piece of equipment. The phase measuring system is based on servo-mechanical principles and utilizes the phase difference between ground and sky waves as an error to be annulled.

The equipment consists of three main units plus accessory circuits. The Gating unit functions to separate the ground wave from the sky wave. The Amplifier and Phase Coherent Oscillator unit provides A.G.C., a varying D.C. current proportional to the amplitude of the sky wave, and a prolonged r-f pulse phase locked with the ground wave. The Phase Detector and Servo unit provides for phase detection between echo and phase locked signal. The sensitivity of the phase measuring equipment is four degrees, and the operating frequency is 60 kc/s.

Field testing of equipment was carried out for a period of five months and performance was satisfactory. Photographs of sample data are enclosed.

A preliminary analysis on data was carried out. A mean fading speed of 16.7 max./hr. for amplitude and 13.3 max./hr. for phase was obtained. These results are consistent with other published data. Fade period histograms for 60 kc/s night-time data show no marked asymmetry between amplitude and phase such as were obtained at 150 kc/s. A cross-correlation analysis between phase and amplitude fluctuations was carried out for ten one hour samples. Substantial positive correlation was found for six out of the ten samples. These results are in contrast with night-time data at 150 kc/s for which the correlation was usually zero.

A theoretical discussion of electromagnetic propagation through a turbulent medium is included. The theory is based on an extended geometrical-optics method in which off-axis scattering by eddies is taken into account. The auto-correlation functions for amplitude and phase are determined as well as the cross-correlation ratio. Weak, three dimensional perturbations of the refractive index were assumed and the random variations specified by a Gaussian auto-correlation function.

For a shallow layer (Fresnel region) the cross-correlation ratio is equal to 0.6 and independent of the actual layer thickness. This result indicates that as far



as the ratio is concerned the hypothetical layer could be replaced by a phase modulating screen. On the other hand, the ratio of intensities  $(H=(\Delta\phi)_{rms}/(\Delta E/E_o)_{rms})$  for the layer and phase screen showed a lack of coincidence. At the bottom of the layer of thickness "L" it was shown that  $H_L=(3\frac{1}{2}\bar{n})H_oL$ , where  $H_oL$  refers to the phase screen results. It was assumed that this relationship was valid for distances beyond "L." Depending on the value of  $\bar{n}$ , the focusing mechanism can give rise to H greater or less than unity even in the Fraunhofer region. This conclusion explains the value of two for H obtained at 150 kc/s and one-half at 60 kc/s. It is concluded that the focusing mechanism appears to be valid at 60 kc/s as well as at 150 kc/s, although the effects of absorption should not be overlooked.

Two different possible methods for determining the height of electron irregularities in the ionosphere are outlined. Microfilm \$2.55; Xerox \$8.80. 195 pages.

## PHYSICS, METEOROLOGY

### THE FORMATION OF THE LOWER IONOSPHERE

(L. C. Card No. Mic 60-5409)

Arthur Coldren Aikin, Jr., Ph.D.  
The Pennsylvania State University, 1960

This thesis is a theoretical study of the physical and chemical processes involved in the formation of the ionospheric D and E layers, that is the region between 60 and 150 km. The problem is treated from the standpoint of the production of free electrons, resulting from the photoionization of atmospheric gases by solar radiation, and the loss of these electrons by their reactions with the ionized and remaining neutral atmospheric particles. Both daytime and twilight conditions are considered.

It is shown that the ionizing agents responsible for the normal D region below 85 km are ultraviolet radiation of wavelength 1215.6 Å, which ionizes nitric oxide, and cosmic rays acting on molecular oxygen and nitrogen. During solar flares, the normal electron density distribution is enhanced by the added ionization due to x-rays, whose wavelength is less than 10 Å.

X-rays of 30 to 40 Å penetrate to the region between 85 and 100 km. Above 100 km longer wavelength x-rays,  $\lambda < 100$  Å produce most of the ionization. However several chromospheric radiations also liberate electrons in this height range and one in particular, Lyman beta at 1026 Å, is responsible for the maximum of the E layer.

A sunrise model of the lower ionosphere likewise is developed. It is shown that the increase in optical depths, to lower heights, at this time leads to reduced E and upper D region electron densities, but that cosmic ray ionization is still active as well as photodetachment of negative ions by visible light. The resulting profile is compared with the requirements for the propagation of low and very low frequency waves.

A summary of the important experimental findings for this part of the ionosphere is given. Methods are derived

for finding the values from theoretical models of three of the parameters measured by vertical-incidence pulse soundings of the ionosphere. No attempt is made at a detailed comparison between theory and experiment, but the complexities of the problem are discussed.

Suggestions are presented for future studies of the theoretical problem of the formation of the lower ionosphere. Microfilm \$2.50; Xerox \$7.40. 158 pages.

## ATMOSPHERIC INFRARED RADIATION

(L. C. Card No. Mic 60-3515)

John L. Gergen, Ph.D.  
University of Minnesota, 1960

This study is a review of the fundamental properties of the infrared radiation by the earth and its atmosphere. The treatment includes the concepts and formalism involved in an analysis of the problem, derivations of the expressions for quantities physically observable (radiation temperature, up flux, etc.), and derivations of the more fundamental quantities used to obtain numerical approximations to the physical observables. Particular attention is directed to the experimental measurements which have become available in recent years. Descriptions of the various infrared-measuring instruments, their limitations and advantages, and typical results of their use are included to illustrate agreement or disagreement with the results of calculation.

Microfilm \$2.75; Xerox \$9.70. 212 pages.

## EVALUATION OF THE KINEMATIC METHOD FOR MEASURING LARGE-SCALE VERTICAL AIR MOTION IN WINTER

(L. C. Card No. Mic 60-5441)

David L. Jones, Ph.D.  
The Pennsylvania State University, 1960

The problem of evaluating large-scale vertical air motion in winter is considered for a twofold purpose: 1) whether or not the kinematic technique for determining vertical motion is practical for prognostic purposes; and 2) whether or not the method is applicable in vertical motion research.

Theory, advantages, and limitations of five vertical motion techniques are discussed. To determine vertical motion by the kinematic method, the vertically-integrated horizontal mass divergence must be measured. A parameter called the approximate resultant vector is derived for this purpose. Less than 2 per cent error is made by using the approximate vector, hence it is employed throughout this research instead of the laboriously-produced exact resultant vector. The effect of variation in balloon ascent rates on the resultant vector is found to be negligible.

Several methods for determining vertical motion by the kinematic method are investigated. The isogon-component technique is found to be most efficient. The proper size for a unit area over which the divergence

should be computed to yield vertical motion is 5 deg lat square.

Vertical velocities at 3 km were computed over the eastern United States twice a day for one winter month. Instantaneous kinematic vertical velocities are found to be less reliable than the average of two successive instantaneous values. Averaging two successive vertical velocity values gives as reliable results for vertical motion as can be obtained from other large-scale vertical motion techniques.

Major errors in the kinematic values stem from the inability to obtain extreme accuracy from the horizontal wind field. Large random variations are found in kinematic data which, when averaged over 12 hours, produce an observed variance of  $2 \text{ cm}^2 \text{ per sec}^2$ ; true and error variances each produce half of this figure. Variances from instantaneous kinematic values are about 15 per cent greater.

A study was made of the usefulness of the kinematic vertical motion values as predictors of weather parameters. Comparisons of several methods show that weather is associated in logical fashion with vertical velocities 9 hours earlier, when moisture is added as a third variable.

Applications of the kinematic technique are discussed. In testing for diabatic effects in the atmosphere, it is shown that eddy heat conduction contributes diabatic warming of  $2.5^\circ\text{C}$  per day in southward-moving air at 700 mb. Comparable convective cooling in northward-moving air is likely to be offset by the released heat of condensation. By evaluating the curl of the surface stress, it is found that, in strong cyclonic flow, low-tropospheric friction contributes  $0.5 \text{ cm per sec}$  at the top of the friction layer to the total vertical velocity.

It is concluded that, because of the large random errors, it is impractical to use the kinematic method as an aid to weather prognoses with the accuracy and spatial distribution of present-day upper winds data. The meridional wind component is nearly as accurate and is available with much less effort. A fourfold increase of the present number of winds aloft stations over the continental United States would be necessary to reduce the error in kinematic vertical velocities to 10 per cent of the average maximum value over a 5 deg lat square.

The kinematic method is applicable in research for estimating the validity of various physical assumptions (such as friction and eddy heat conduction) which are commonly made about atmospheric models.

For further study, tests are proposed for increasing the accuracy and speed of computation of kinematic vertical velocities, and for studying their patterns on a diurnal and seasonal basis and as a function of height.

Microfilm \$2.50; Xerox \$6.00. 121 pages.

## THE MEASUREMENT OF SECULAR TEMPERATURE CHANGE IN THE EASTERN UNITED STATES

(L. C. Card No. Mic 60-5449)

John Murray Mitchell, Jr., Ph.D.  
The Pennsylvania State University, 1960

Long series of observations at climatological stations, commonly used for estimating secular climatic change, are frequently unreliable for such an application. The purpose of this thesis is to develop and apply an optimum methodology for measuring secular changes of temperature, by use of existing monthly mean data at cooperative climatological stations, with particular reference to the eastern United States.

Classical methods of verifying the geographical representativeness (i.e., homogeneity) of secular temperature series are critically reviewed, and limitations inherent in them are outlined. Three fundamentally distinct methods of using mean-temperature data at stations within appropriately defined geographical regions are described, for the purpose of estimating secular change in such regions. These methods are respectively embodied in (1) the reference-station index, in which the series for a selected station is used to represent regional secular change; (2) the area-mean index, in which all available reports of temperature in the region are averaged year by year; and (3) the tau index, developed by the writer, in which all available temperatures in the region are first expressed in the form of first temperature differences and then combined in such a manner that the deleterious effects of interstation microclimatic variation and of documented station relocations on the area-mean index are eliminated. On the basis of a generalized statistical model, according to which occurrences of missing data and station relocations are distributed at random in time and among the stations in a region, the error variances of the three secular-change indices are determined and compared for conditions typical of the eastern United States.

For secular intervals in excess of about 50 years, the reference-station index is concluded to be superior to other indices, provided, however, that the reference-station record is in fact homogeneous. The tau index is shown to be a valuable tool for verifying the homogeneity of reference-station series. A statistical test of suspected inhomogeneities in such series, involving the tau index, is proposed which largely avoids the limitations of classical homogeneity analysis.

The temperature records for 13 stations proposed for the U. S. Weather Bureau Climatological Benchmark Network, and those for 10 Weather Bureau city stations, all in the eastern United States, are analyzed for homogeneity. It is shown that most of the benchmark candidate-station records contain inhomogeneities of a discontinuous character, apparently related to changes of station location. Most of the city-station records are found to contain inhomogeneities of a progressive character, probably due to the warming influence of secular growth of the cities. Contrary to earlier inferences, this excess city warming is shown to be concentrated in the warmest months of the year, and often to be negligibly small in winter.

It is concluded that errors of measurement of secular temperature change by means of reference-station series can be appreciably lessened by exposing the station



thermometers at a relatively high ground elevation, and by the use of auxiliary instrumentation to maintain a high quality of the observations. Inhomogeneities in many station series can be isolated which, if disregarded, can lead to incorrect qualitative as well as quantitative conclusions concerning the character of secular temperature change. Microfilm \$2.50; Xerox \$7.60. 163 pages.

## PHYSICS, NUCLEAR

### GAMMA-GAMMA DIRECTIONAL CORRELATIONS IN $\text{Nd}^{147}$

(L. C. Card No. Mic 60-5411)

Atam Parkash Arya, Ph.D.  
The Pennsylvania State University, 1960

Directional correlation measurements have been made on the 320--92-keV and 280--320-keV gamma ray cascades in  $\text{Pm}^{147}$  following the decay of 11.1 day  $\text{Nd}^{147}$  with a coincidence scintillation spectrometer using NaI detectors. The observed correlation functions are:

$$W(\theta) = 1 - (0.1030 \pm 0.0298) P_2(\cos \theta) + (0.0107 \pm 0.0099) P_4(\cos \theta)$$

and

$$W(\theta) = 1 + (0.0710 \pm 0.0162) P_2(\cos \theta) - (0.0126 \pm 0.0103) P_4(\cos \theta)$$

respectively for the two cascades. The energy-levels of  $\text{Pm}^{147}$  at ground-state, 92-keV, 410-keV, and 690-keV were

found to be  $\frac{5^+}{2}$ ,  $\frac{7^+}{2}$ ,  $\frac{5^+}{2}$ , and  $\frac{5^+}{2}$ , respectively. It was

found that the 92-keV gamma ray has a mixture of  $(95 \pm 2)\%$  M1 and  $(5 \pm 2)\%$  E2 with  $\delta = -0.229 \pm 0.143$ , the 320-keV gamma ray has a mixture of  $(95 \pm 1)\%$  M1 and  $(5 \pm 1)\%$  E2 with  $\delta = +0.229 \pm 0.102$  and the 280-keV gamma ray has a mixture of  $(1.0 \pm 0.5)\%$  M1 and  $(99.0 \pm 0.5)\%$  E2 with  $\delta = +9.95 \pm 0.71$ .

Microfilm \$2.50; Xerox \$5.80. 116 pages.

### PSEUDOSCALAR INTERACTION IN NUCLEAR BETA DECAY

(L. C. Card No. Mic 60-4668)

Chander Perkash Bhalla, Ph.D.  
The University of Tennessee, 1960

Major Professor: M. E. Rose

The experiments on allowed  $\beta$  transitions, which have provided virtually a unique interpretation of the beta interaction in the form of the V-1.2A law, shed no light on the question of the possibility of a contribution from the pseudoscalar interaction. In order to determine

whether such a contribution is really needed, we have examined the  $0 \rightarrow 0$  (yes) beta transitions. The only relevant experimental data are the  $\beta$  longitudinal polarization and the  $\beta$  spectrum. Using the form of the pseudo-scalar interaction,<sup>1</sup> which results from the Foldy-Wouthuysen transformation, the  $\beta$  longitudinal polarization, resulting from the A and P mixture, has been calculated. The calculated  $\beta$  polarization and  $\beta$  shape factor depend on two parameters, namely, (1) the ratio of the coupling constants of the P and the A interactions and (2) the ratio of the nuclear matrix elements.

We have tabulated the  $\beta$  longitudinal polarization and the  $\beta$  shape factor for  $\text{Pr}^{144}$  ( $0^- \rightarrow 0^+$ ) and  $\text{Ho}^{166}$  ( $0^- \rightarrow 0^+$ ) considering the nucleus to be a sphere of a uniform charge distribution with the nuclear radius as  $1.2 A^{1/3} 10^{-13}$  cm and properly taking into account the finite deBroglie wavelength effect. We have carried out an extensive numerical analysis of the accurate experimental data on  $\text{Pr}^{144}$  ( $0^- \rightarrow 0^+$ ), namely, (1) the  $\beta^-$  longitudinal polarization measurement of Mehlhop et al.<sup>2</sup> and (2) the  $\beta^-$  shape factor of Porter and Day,<sup>3</sup> as well as of the  $\beta^-$  longitudinal polarization measurement of  $\text{Ho}^{166}$  due to Bühring.<sup>4</sup>

The conclusions are that (1) the absence of the pseudo-scalar interaction is consistent with the existing experimental data and (2) the upper limit on  $|\overline{C_P/C_A}|$ , which also gives a fit to the experimental data, is 90 which is about half the previous estimate<sup>5</sup> as appears in the literature. The assumptions made are: time reversal invariance for the strong as well as for the weak interactions is valid and the two component theory of the neutrino is used. It is pointed out that accurate measurements of the  $\beta$  longitudinal polarization (with an accuracy  $\sim 1\%$ ) at four or five different beta momenta and the beta shape factor in the  $0 \rightarrow 0$  (yes) transition can settle the question of the existence of the pseudoscalar interaction in the nuclear beta decay.

1. M. E. Rose and R. K. Osborn, Phys. Rev. **93**, 1315 (1954).
2. W. A. W. Mehlhop, E. D. Lambe, and T. Pond, Bull. Am. Phys. Soc. **5**, 9 (1960) (New York Meeting) and also W. A. W. Mehlhop, Ph.D. dissertation (unpublished), The Washington University, Saint Louis (1959).
3. F. T. Porter and P. P. Day, Phys. Rev. **114**, 1286 (1959).
4. W. Bühring, Z. Physik **155**, 566 (1959).
5. R. L. Graham, J. S. Geiger and T. A. Eastwood, Can. J. Phys. **36**, 1084 (1958), and also Mehlhop et al, loc. cit.

Microfilm \$2.50; Xerox \$8.60. 187 pages.

### TRANSVERSE POLARIZATION OF CONVERSION ELECTRONS FOLLOWING BETA-DECAY

(L. C. Card No. Mic 60-3882)

Renato Bobone, Ph.D.  
University of Illinois, 1960

The transverse polarization of K-shell conversion electrons following beta-decay in  $\text{Hg}^{203}$  was measured by a beta-conversion electron correlation experiment. Transversely polarized K-electrons were energy selected

by a double lens magnetic spectrometer with opposite fields for compensation of spin rotation. The focussed beam was scattered at  $90^\circ$  by a gold target oriented at  $45^\circ$  to the spectrometer axis. Coincidence measurements were taken between the right and left scattered electrons and the betas detected normally to the Mott scattering plane. The right/left asymmetry so obtained was first corrected for instrumental asymmetry by a second correlation measurement in which betas in the direction of the spectrometer axis were detected. The right/left coincidence ratio, thus normalized for instrumental asymmetry, was used to calculate the transverse polarization by introducing corrections for depolarization in the source and in the target, and for averaging over solid angles and  $v/c$ . The resulting transverse polarization was  $P = (.50 - .10) (v/c) \sin \theta$ .

Microfilm \$2.50; Xerox \$7.00. 148 pages.

#### ALUMINUM ( $p, \gamma$ ) RESONANCES WITH $H_1^+$ , $H_2^+$ AND $H_3^+$ IONS.

(L. C. Card No. Mic 60-6525)

Per Fridtjof Dahl, Ph.D.  
The University of Wisconsin, 1960

Supervisor: Professor Raymond Herb

Resonances in the  $Al^{27}(p, \gamma)Si^{28}$  reaction were studied with  $H_1^+$ ,  $H_2^+$  and  $H_3^+$  ions, under a variety of conditions, to clarify discrepancies between molecular ion results and results with  $H_1^+$  ions. Thick target gamma-ray yield curves from  $H_2^+$  and  $H_3^+$  ions are very asymmetric and somewhat complicated in shape. Yield curves from  $H_1^+$  ions are accurately fitted by assuming the electron in the ion is torn away the moment the target is struck. The subsequent Coulomb force between the two protons pushes them apart. A proton oriented forward in the ion receives an impulse in the forward direction, and the trailing proton a retarding impulse. Proton energies in the laboratory system are substantially changed, and the shape of yield curves radically altered. Six resonance energies were measured with protons, in terms of the  $Li(p, n)$  threshold, taken as 1881.1 keV. Values obtained are, in keV,  $632.8 \pm 0.2$ ,  $923.4 \pm 0.3$ ,  $937.7 \pm 0.3$ ,  $992.4 \pm 0.3$ ,  $1001.7 \pm 1.0$  and  $1213.6 \pm 0.5$ .

Microfilm \$2.50; Xerox \$4.00. 73 pages.

#### DECAY OF ${}_{68}Er^{161}$ (3.1 hr)

(L. C. Card No. Mic 60-5661)

Herbert Allan Grench, Ph.D.  
State University of Iowa, 1960

Chairman: Professor James A. Jacobs

Sources of  ${}_{68}Er^{161}$  (3.1 hr) were produced by the  $(n, 2n)$  and  $(\gamma, n)$  reactions. A study of the gamma-ray spectrum by means of scintillation coincidence spectrometry indicated 32 gamma rays. All but three of these are fitted into

a tentative decay scheme with levels at 0, 211, 585, 826, 945, 1165, 1253, 1315, 1395, 1450, (1604), 1700, and 1830 keV. The data are consistent with a  $3/2^-$  spin assignment to the Er ground state and  $7/2^-$  and  $1/2^+$  assignments to the ground state and 211-keV state of Ho, respectively. The 826-keV level in Ho probably has  $5/2^-$  character.

Microfilm \$2.50; Xerox \$3.00. 39 pages.

#### TIME-REVERSAL INVARIANCE IN STRONG INTERACTIONS

(L. C. Card No. Mic 60-6526)

Gareth Eugene Guest, Ph.D.  
The University of Wisconsin, 1960

Supervisor: Professor Marvin E. Ebel

A possible approach to the problem of experimental verification of the time-reversal invariance of strong interactions is developed which attempts to relate charge symmetry, charge independence and charge conjugation invariance in such a way that the experimental demonstrations of charge independence might be used to imply time-reversal invariance. Resumes of experimental tests of time-reversal invariance, charge symmetry and charge independence are presented which lead to the conclusions that

- (i) whereas there are no experimental data which demand the failure of time-reversal invariance of the strong interactions, there are no really unambiguous experimental verifications of this hypothesis;
- (ii) there is very good evidence for the charge symmetry and, to a lesser extent, the charge independence of strong interactions; and that
- (iii) if the strong interactions are describable by a Yukawa, single meson exchange potential, the condition of charge independence guarantees that the interaction will be charge conjugation invariant, and, using the TCP theorem, time-reversal invariant.

The effect of the presence of a time-reversal variant part in the strong interactions which "dress" the bare beta decay of a free neutron is calculated. Any departures from the usual spectrum of decay electron energies resulting from the presence of the time-reversal variance are diminished with respect to the invariant contributions by a factor of the order of magnitude of 0.1% and hence will be, for all practical purposes, unobservable. The amplitudes of correlations of the form  $\vec{\sigma}_n \cdot (\vec{\rho}_e \times \vec{\rho}_\nu)$ , however, are found to be quite sensitive to the presence of irreversible nucleon-K-meson- $\Sigma$ -hyperon interactions, their coefficient,  $D$ , being linear in the parameter which measures the degree of the noninvariance.

Microfilm \$2.50; Xerox \$4.00. 72 pages.



# K ELECTRON EXCITATION ACCOMPANYING K CAPTURE IN Cs<sup>131</sup>

(L. C. Card No. Mic 60-6462)

Neil LaVern Lark, Ph.D.  
Cornell University, 1960

When an atom decays by K electron capture, there is a small probability that the second K electron is excited by the electromagnetic interactions during the transmutation. This produces an atom with a completely vacant K shell. This phenomenon has been observed in the K-capture decay of Cs<sup>131</sup> by detection of two K X-rays emitted simultaneously from the atom. The X rays were detected in thin NaI(Tl) crystals. By use of the pulse clipping technique and a fast-slow coincidence spectrometer, it was possible to attain a coincidence resolving time of ten millimicroseconds and an energy resolution of thirty per cent for 30 keV X rays. The relative frequency of the electron excitation phenomenon has been measured to be  $(2.5 \pm 0.2) \times 10^{-5}$  per K electron capture event in Cs<sup>131</sup>. This is smaller by a factor of about two than the relative frequency calculated by use of the sudden-perturbation approximation. The half-life of Cs<sup>131</sup> has been redetermined to be  $9.69 \pm 0.05$  days. This value is in accord with results of measurements previously reported, but is more accurate.

Microfilm \$2.50; Xerox \$5.20. 101 pages.

# NEUTRONS FROM THE CAPTURE OF A POLARIZED MU MESON

(L. C. Card No. Mic 60-5832)

Elihu Lubkin, Ph.D.  
Columbia University, 1960

The angular distribution of the neutrons from the capture by a spinless nucleus of a totally polarized  $m\mu$  meson in the 1s Bohr orbit, is calculated via two single-particle nuclear models, termed "modified Fermi gas" and "square well." A direct 4-fermion coupling, with a left-handed neutrino, represents the weak interaction. The major results depend on the Fermi, Gamow-Teller, and pseudo-scalar coupling constants:  $c_F$ ,  $c_G$ ,  $c_P$ . The angular distribution is  $1 + \kappa (C_-/C_+) \cos \theta$ , where  $\theta$  is the angle from the muon's spin to the neutron's momentum,  $C_{\pm} = |c_F|^2 \pm 2|c_G|^2 + |c_G - (p/2M)c_P|^2$ ,  $p$  is the neutrino's energy,  $M$  is the rest energy of a nucleon, and  $\kappa$  is the calculated asymmetry reduction factor.

The "modified Fermi gas" calculations, performed for Ca<sup>40</sup> and Pb<sup>208</sup>, employ a Fermi sea of protons and  $\mu^- + p \rightarrow \nu + n$  to produce neutrons at a localized zone of the nucleus, which are followed through the nuclear surface via geometrical optics. Those neutrons which escape at this stage of the calculation are termed "direct neutrons," and a  $\kappa$  restricted to direct neutrons is  $\sim 0.7$ . Due to total internal reflection and attenuation, most neutrons don't escape directly. Captured neutrons are assumed to excite boil-off, which is isotropic, and which strongly dominates the lower 2/3 of the neutron energy

spectrum. The top quarter of the spectrum is nevertheless relatively free from boil-off.

The "square well" calculations, performed for O<sup>16</sup>, Si<sup>28</sup>, and Ca<sup>40</sup>, employ eigenfunctions of a real square well of finite depth for the nucleons, and a spherical harmonic expansion up to g waves, inclusive, of the neutrino plane wave.  $\kappa$  ranges from several to  $\sim 30$  per cent. In such a single-particle model upper shells are found to dominate strongly captures with productions of free neutrons.

The case of rarefied hydrogen is treated in an appendix.

Microfilm \$2.50; Xerox \$6.60. 137 pages.

# SEMI-CLASSICAL APPROXIMATIONS IN HIGH ENERGY SCATTERING THEORY

(L. C. Card No. Mic 60-5609)

Mervine Rosen, Ph.D.  
University of Minnesota, 1960

Adviser: Donald R. Yennie

A modified WKB approximation is described and applied to the extreme relativistic Dirac radial equations and phase shifts are calculated, to the first two orders in the approximation, for the scattering of high energy electrons from a spherically symmetric static nuclear charge distribution. The method is then extended to the radial Schrodinger equation and phase shifts derived, also to second order, for scattering from a central nuclear potential.

The application of the three-dimensional semi-classical approximation is then made to two problems not previously treated in this manner. The equations governing the projection of the spin of a Dirac particle, parallel and anti-parallel to its momentum, moving in a conservative force field, are given; and the spin flip term is evaluated in the non-relativistic and extreme relativistic limits. The three-dimensional Schrodinger equation is then investigated in the WKB approximation; the flux and the divergence and curl of the flux of a beam of particles traveling in a complex potential well are calculated. A comparison is made with the classical calculation of Eisberg, McCarthy and Spurrier<sup>1</sup> and corrections to their formulae are indicated and explicitly evaluated for the case of a uniform central potential.

1. R. H. Eisberg, I. E. McCarthy, and R. A. Spurrier, Nuclear Physics 10, 571 (1959).

Microfilm \$2.50; Xerox \$4.60. 87 pages.

# THE ATTENUATION OF DELAYED FISSION NEUTRONS IN VARIOUS SHIELDING MATERIALS

(L. C. Card No. Mic 60-5251)

Henry Hugo Samuelson, Ph.D.  
The University of Connecticut, 1960

The attenuation characteristics of the delayed neutrons from fission had not been measured previously. The problem of shielding personnel from these particular radiations would become a problem only for circulating fuel reactors. At the present time, research on circulating fuel reactors has been slowed down in this country in order to concentrate effort on the more conventional types of reactors. This experimental investigation was undertaken to have some data available when shielding for circulating fuel reactors has to be designed.

Carriers, containing approximately 5 mg of  $U^{235}$ , were used as the source of delayed neutrons. They were exposed near the center of the large Brookhaven National Laboratory reactor and ejected pneumatically to the middle of a concrete stack. Nine blocks, each 72" x 72" x 8" high, were stacked to form a 6' cube. Experiments were carried out with four types of concrete: barytes, ilmenite, ferrous phosphate, and ordinary concrete.

The small source emitting the delayed neutrons in the center of this large volume of concrete acted effectively as a point source in an infinite attenuating medium. The neutron intensity at various distances from the source was measured by activation induced by the neutrons in indium foils and by a  $BF_3$  counter. The data obtained from these measurements were analyzed in terms of two exponentials corresponding to the attenuation of the fast and thermal neutron fluxes in the assembly. This permitted the calculation of the Fermi age and thermal diffusion lengths for the various shielding materials.

Microfilm \$2.50; Xerox \$3.80. 67 pages.

## PHYSICS, SOLID STATE

### A NEUTRON DIFFRACTION STUDY OF NICKEL OXIDE

(L. C. Card No. Mic 60-5216)

Harvey Albert Alperin, Ph.D.  
The University of Connecticut, 1960

Nickel oxide is a simple example of an antiferromagnetic material exhibiting the fundamental superexchange interaction. It has been extensively studied in the past. The early neutron diffraction work by Shull, on a powder sample of  $NiO$ , established its basic antiferromagnetic character. A later neutron diffraction investigation of a powder sample by Roth showed the ordering to consist of a next nearest neighbor antiferromagnetic coupling of  $Ni^{++}$  ions, with the spin moments lying, most probably, within the (111) plane. It is necessary, however, to use a single crystal sample in order to uniquely determine the spin direction in a single spin axis model, or to investigate

the possibility of a multi-axis spin arrangement. Unfortunately, unless the single crystal is specially treated, it will consist of a large number of small rhombohedral twins, still making a unique determination of the magnetic structure impossible.

For the present investigation, a pressure annealed crystal was used to eliminate most of the twinning. The crystal was loaned by Professor Uchida of the University of Osaka Prefecture, who carefully prepared it by heating it to 800°K and then applying compression along a [111] direction as the crystal cooled to room temperature.

Equipment for neutron diffraction was set up for this investigation at the Naval Research Laboratory reactor, and room temperature measurements were performed on the crystal described above, as well as on two other crystals subject to different initial preparations. The nuclear reflections, as well as the purely magnetic reflections (which arise from the magnetic superlattice), were measured. The nuclear reflections were used for calibration, to put the magnetic intensities on an absolute basis. The method of least squares was used to fit the calculated to the observed intensities for both nuclear and magnetic reflections. The effects of absorption and secondary extinction were included in the analysis of the data. These calculations were programmed for the IBM 704 computer.

The principal results of this investigation can be summarized as follows. The crystal was rendered sufficiently free of twins (approximately 82%) to make it possible to unambiguously determine that a multi-axis spin structure is not possible for  $NiO$ . The magnetic scattering can be fitted by a single spin axis model having spins lying in (111) planes. Within each (111) plane, all the spins are parallel to one another; successive (111) planes have the directions of their spins alternately parallel and antiparallel. A symmetrical distribution of antiferromagnetic domains is found to be present within each (111) plane. The magnetic form factor curve for  $Ni^{++}$  is found to lie well above the  $Mn^{++}$  curve, and in fact, close to the form factor for nickel metal. In the region  $0.1 < (\sin\theta/\lambda) < 0.45$ , the form factor is well represented by an exponential dependence on  $(\sin\theta/\lambda)^2$ . The effective spin value  $S$  for  $Ni^{++}$  is found to be  $S = 0.92 \pm 0.13$ .

Microfilm \$2.50; Xerox \$4.80. 91 pages.

### LOW TEMPERATURE THERMOELECTRIC POWER OF RARE EARTH METALS

(L. C. Card No. Mic 60-5873)

Harold Joseph Born, Ph.D.  
Iowa State University of Science and Technology, 1960

Supervisor: Sam Legvold

The Seebeck coefficients (or thermoelectric power) of yttrium, lanthanum, and eleven of the rare earths have been measured as a function of temperature for the temperature range of approximately 7° K to 300° K. A  $\Delta T$  of some 2° to 5° C was used between the two ends of a 3/16" diameter by 2" long sample. The anomalous behavior reported by other investigators on specific heat, magnetic moment, resistivity, and heat capacity at the magnetic



ordering temperatures is, in many instances, visible also in the curves of thermoelectric power versus temperature.

With the exception of samarium and ytterbium, the TEP's of the metals measured are negative throughout most of the temperature range covered. Lanthanum, neodymium and praseodymium, which have a double c-axis hexagonal close-packed crystal structure, have TEP's that show the same general temperature dependence. Also, the curves of the TEP of yttrium and lutetium, with filled inner shells, show striking similarities.

The transition from paramagnetism to either ferromagnetism or antiferromagnetism makes itself evident on the curves as a change in slope. However, the transition from ferromagnetism to antiferromagnetism shows up on the curve as a step in the one case (dysprosium) where it is unmistakably evident.

Microfilm \$2.50; Xerox \$6.00. 125 pages.

#### SUPERCONDUCTING TRANSITION TEMPERATURES OF TITANIUM AND TITANIUM ISOTOPES

(L. C. Card No. Mic 60-6528)

Richard Gary Netzel, Ph.D.  
The University of Wisconsin, 1960

Supervisor: Associate Professor Joseph R. Dillinger

The study of the superconducting transition temperatures of titanium was initiated because of a prediction of deviations from the  $M^{-\frac{1}{2}}$  dependence of  $T_c$ , because of the availability of isotopically enriched samples, and because of the availability of a calorimeter which could easily be adapted for the measurements.

The calorimeter used was a double capsule type consisting of a paramagnetic salt refrigerator and a sample chamber. Liquid helium II in both capsules and in a small pipe connecting the two assured thermal equilibrium among the salt, the samples and the thermometers (two carbon composition resistors).

Each of three secondary coils, having a titanium-sample core, could be connected alternately in series opposition with a fourth to form an astatic secondary pair of a mutual inductance circuit. Thus it was possible to record a transition curve for three samples during the warm-up after each demagnetization. An a.c. null-detection scheme was used in which the maximum measuring field was computed to be less than 0.01 oersted. All measurements were made in zero applied field.

Three titanium samples,  $Ti^{46}$ ,  $Ti^{48}$  and  $Ti^{50}$ , enriched to an isotopic concentration of at least 85 percent, were measured and found to have transition temperatures of 0.36°, 0.22° and 1.11°K respectively. Though the measurements were made on the best available samples of titanium, it is clear that other factors are more effective than variations in isotopic constitution in bringing about changes in the transition temperature.

A chemically pure polycrystalline titanium bar prepared by the iodide process was machined into a long cylinder and found to have a transition temperature of 0.27°K. The possibility of sample differences causing the

discrepancy among all measurements of the transition temperature of pure titanium must be recognized. But on the basis of thermal equilibrium arguments only, it is reasonable that this measurement is the best that has been made.

Two samples of quite pure but highly strained titanium prepared by electrolytic deposition from fused titanium salts by the U. S. Bureau of Mines showed no evidence of superconductivity down to 0.2°K. Two 100 and 325 mesh samples obtained from the A. D. MacKay Co. with a quoted purity of 99.5 percent showed only feeble signs of superconductivity down to 0.2°K.

The results are discussed in the light of known properties of hard superconductors and suggestions are made for future investigations.

Microfilm \$2.50; Xerox \$5.20. 105 pages.

#### INVESTIGATION OF LOW TEMPERATURE ULTRASONIC ABSORPTION IN FAST-NEUTRON IRRADIATED FUSED SILICA

(L. C. Card No. Mic 60-5256)

Robert Ernest Strakna, Ph.D.  
The University of Connecticut, 1960

Ultrasonic attenuation measurements have been made in normal and fast neutron irradiated fused silica from 7.1 to 50 Mc/sec and from 1.5 to 200°K. The purpose of this research was to obtain information about the mechanism of the low temperature attenuation as related to the structure of glass and the manner in which it changes with fast neutron irradiation. This study adds to a growing list of properties of fused silica, measured before and after fast neutron irradiation, directed toward a determination of the structure of glass and the mechanism of fast neutron damage.

An apparatus was assembled to measure ultrasonic attenuation and velocity in solids from 1.5° to 373°K and from 5 to 150 Mc/sec. using microsecond pulse techniques. A low temperature sample holder was designed and constructed to provide a constant temperature environment for the sample. A 7 Mc quartz crystal transducer, excited at its fundamental and next 3 odd harmonics, provided the four ultrasonic frequencies used in this study. An excellent mechanical and acoustical bond between the fused silica sample and the quartz crystal transducer was maintained at low temperatures by using a low viscosity silicone oil as a bonding agent.

A broad attenuation curve, attributed to a structural relaxation with a distribution of activation energies, occurs at low temperatures. The shape of the curve is dependent upon the distribution of activation energies and the amplitude is proportional to the number of structural units which contribute to the relaxation process. A heavy fast neutron irradiation of the sample produced no change in the shape of the curve while the amplitude decreased by about 20%. A damaging mechanism which either inactivates or does not noticeably affect the contributing units is indicated. In addition to point defects produced by displacement collisions, thermal spikes have temperatures above the softening point of fused silica, lasting less than  $10^{-12}$  seconds and having radii of the order of

10 Angstroms, are a possible cause of the irradiation-induced change.

Arguments are presented to show that atoms associated with non-impurity structural defects are responsible for the structural relaxation. With the combined information from this study and other work on fast neutron damage in

fused silica, it is still not possible to uniquely determine the nature of the structure of fused silica or the mechanism of fast neutron damage. A consistent explanation of the attenuation as connected to a specific model and a specific mechanism of damage is suggested, however.

Microfilm \$2.50; Xerox \$5.20. 102 pages.

## PHYSIOLOGY

# IN VITRO SYNTHESIS OF PROGESTERONE BY SWINE CORPORA LUTEA

(L. C. Card No. Mic 60-4893)

Gordon Walter Duncan, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: R. M. Melampy

Corpora lutea slices suspended in Krebs-Ringer bicarbonate buffer medium containing glucose are incubated for 2 hours at 37.5°C under 95% O<sub>2</sub>, 5% CO<sub>2</sub>. Following incubation progesterone is isolated and quantitatively estimated by a method based upon 95% ethanol extraction, column adsorption chromatography, counter-current distribution, paper chromatography and ultraviolet absorption spectrophotometry. Initial endogenous and post-incubation progesterone concentrations (mcg/gm) of corpora from gilts 4, 8, 12, 16 and 18 days post estrus are respectively: 21, 158; 40, 113; 61, 135; 74, 146; 0, 0. For animals pregnant 16, 24, 48, 72, 96, and 102 days the concentrations are: 82, 114; 84, 145; 105, 141; 68, 106; 52, 98; 21, 68. Addition of DPN and pregnenolone to the medium increases *in vitro* synthesis whereas HCG, PMS, LTH, oxytocin, relaxin or homogenized gilt pituitary tissue were uniformly unsuccessful in altering the intrinsic capacity of luteal tissue slices to synthesis progesterone under the conditions employed. Intramuscular administration of LTH (125 and 250 I.U./day) initiated 3 days prior to slaughter did not alter the endogenous or post incubation progesterone concentration.

Subtotal hysterectomy prolonged the functional life of gilt corpora lutea as indicated by progesterone content as well as the capacity of this tissue to synthesize progesterone *in vitro*. Endometrial filtrates obtained at days 12 and 13 of the cycle increased *in vitro* synthesis by luteal tissue of the cycle and pregnancy whereas filtrates of days 16 and 18 showed a definite inhibitory effect on hormone synthesis. Preliminary investigations indicated the factor or factors responsible for the observed inhibition of synthesis: were found in solution following protein precipitation; had their specific activity reduced following heating of filtrates; and dialyzed through a cellophane membrane. The possibility of a uterine substance directly or indirectly influencing regression of corpora lutea was considered. Microfilm \$2.50; Xerox \$3.80. 66 pages.

# RADIO TELEMETRY OF ELECTROCARDIOGRAMS AND BODY TEMPERATURES FROM SURGICALLY IMPLANTED TRANSMITTERS

(L. C. Card No. Mic 60-5651)

Warren Orvel Essler, Ph.D.

State University of Iowa, 1960

Chairmen: Associate Professor G. Edgar Folk, Jr. and Professor Lawrence A. Ware

Subdermal transmitters and associated systems were designed for measuring heart rates and body temperatures of medium sized or large animals. Pilot experiments were conducted to test this equipment.

The temperature transmitter would be classified as a long life, short range, small size telemeter, designed to have an operational life exceeding 200 days, a range of several meters, a volume of 9 cm<sup>3</sup>, and to be suitable for surgical implantation. The temperature information is automatically and continuously recorded by the receiving system which uses a conventional communications receiver.

The EKG transmitter, similar in many respects to the other instrument, was designed to have an operational life exceeding 40 days, a range of several meters, a volume of 26 cm<sup>3</sup> and to be suitable for surgical implantation. The receiving system for the frequency modulated signal from the EKG transmitter includes a conventional communications receiver, a commercially available frequency meter and a standard commercially available electrocardiograph. The frequency response of the entire system was adjusted to discriminate against skeletal muscle potentials and enhance potentials developed by the heart.

A comparative heart rate study to determine 24-hour periodicity was conducted using rabbit, cat, and dog. Heart rates of these animals were measured every thirty minutes throughout a three day period. The resulting data were reduced to quantitative expressions through the use of Fourier analysis. Several unusual heart rate characteristics were also noted.

Simultaneous heart rates and body temperatures were recorded for periods up to 24 hours. A temperature transmitter, surgically implanted, operated continuously for over 2 weeks (one instrument operated over 5 months). The implanted transmitter was used to measure temperature in a vascular area near the right kidney; another transmitter carried on a harness recorded heart beats and the shape of the EKG waveform. The 24-hour experiment



showed a clear-cut daily rhythm and a close interrelationship between temperature and heart rate.

Other experiments were conducted to perfect and illustrate implantation techniques with radio telemeters.

Microfilm \$2.50; Xerox \$5.60. 115 pages.

AN EVALUATION OF A THERMAL DILUTION  
METHOD USING ROOM TEMPERATURE  
ISOTONIC SALINE AS THE DILUTION  
INDICATOR FOR ESTIMATING THE CARDIAC  
OUTPUT IN THE INTACT ANIMAL

(L. C. Card No. Mic 60-5652)

Eugene Evonuk, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor Charles J. Imig

Studies were carried out to evaluate the thermal dilution method using room temperature isotonic saline as the dilution indicator for estimating the cardiac output in the intact animal.

A technique was developed for recording time concentration curves utilizing the thermal dilution method using room temperature isotonic saline as the dilution indicator for estimating the cardiac output in the intact animal. This technique depended upon accurate and fast recording of the blood temperature changes which occurred in the aorta and pulmonary artery when room temperature isotonic saline was injected into the superior vena cava.

This technique was compared with the dye dilution method by recording 132 aortic thermal dilution curves and 132 dye dilution curves measured simultaneously for estimating the cardiac output in the intact animal. The coefficient of correlation between these two methods was 0.962. The difference between the means was 3.22% and was not statistically significant. The mean percent difference when the thermal dilution method was compared with the dye dilution method was +3.9% and was statistically significant. This difference was considered to be well within the range of accuracy of the dye dilution method.

The usefulness of the thermal dilution method using isotonic room temperature saline as the indicator for the estimation of right heart outputs was also determined. This was accomplished by comparing measurements of the right heart output with simultaneously measured left heart outputs using the thermal dilution method. The coefficient of correlation between the measurements of 54 right heart outputs and 54 left heart outputs was 0.96. The difference between the means was 1.6% and was not statistically significant. The mean percent difference was -1.6% and was statistically significant. The thermal dilution method using room temperature saline as the dilution indicator provides a very suitable means for estimating both right and left heart outputs.

A formula was advanced for calculating the thermal dilution curves which was based on well established mathematical and thermodynamic principles which gave an expression of the cardiac output in cc. per minute.

Microfilm \$2.50; Xerox \$4.60. 87 pages.

THE INFLUENCE OF BARBITURATES  
AND MUSCLE RELAXANT DRUGS  
(PENTOBARBITAL, PENTOTHAL,  
GALLAMINE TRIETHIODIDE AND TUBOCURARINE)  
ON CERTAIN CARDIOVASCULAR  
AND RESPIRATORY EVENTS.

(L. C. Card No. Mic 60-5660)

Wilbert Greenfield, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor Charles J. Imig

The changes in certain cardiovascular and respiratory events have been studied in dogs under the influence of muscle relaxant drugs, gallamine triethiodide (Flaxedil) and tubocurarine chloride, and combinations of muscle relaxant drugs and barbiturates, pentobarbital sodium and pentothal. Peripheral blood flow and blood pressure were not altered significantly following the administration of Flaxedil. Therefore, it is felt that the caliber of blood vessels and the vasomotor center were not influenced by this drug. Heart rate increased significantly and may be the result of a moderate parasympatholytic action on the vagus nerve. Rectal temperature and hematocrit were not altered appreciably by Flaxedil or tubocurarine. Tubocurarine did not affect appreciably the  $O_2$  consumption and  $CO_2$  production. However, blood pressure decreased with all doses of tubocurarine studied. The greater decreases occurred with the larger doses. Blood flow was decreased only in those animals that showed a marked decrease in blood pressure, which may result from the release of histamine by this drug. Heart rate did not increase significantly with all doses of tubocurarine given. The fact that tubocurarine has both parasympatholytic and sympatholytic actions when relatively large doses are given may account for the fluctuations in heart rate. Following the administration of combinations of Flaxedil and pentothal, cardiac output decreased gradually, showing a statistically significant difference at one and one-half hours. At approximately the same time, peripheral resistance increased significantly and heart rate decreased significantly. Right atrial pressure, arterial pressure and stroke volume were not altered appreciably throughout the experiment. Oxygen consumption remained essentially constant but a small increase in carbon dioxide production was noted at the end of the experiment. The results of this study suggest that Flaxedil may be a desirable agent to employ for controlling the muscular activity of animals in experiments concerned with the measure of blood flow and blood pressure since this drug per se has little or no effect on these variables and thus would permit establishment of their control values. It must be emphasized that animals receiving only Flaxedil for controlling muscular activity are conscious and therefore, are aware of all sensory experiences including pain. The employment of this drug would not be permissible in painful experimental procedures. Microfilm \$2.50; Xerox \$5.40. 110 pages.

**A SOURCEBOOK FOR THE  
LABORATORY INSTRUCTOR IN FIRST COLLEGE  
COURSES IN HUMAN PHYSIOLOGY**

(L. C. Card No. Mic 60-5666)

Henry Huizinga, Ph.D.  
State University of Iowa, 1960

Chairman: Professor H. M. Hines

The Sourcebook is the result of the critical evaluation and development of experiments, both old and new, to make them practical and effective in teaching current human physiology at the college level. The experiments were used and developed in two one-semester human physiology courses during a period of six years at the University of Wyoming. Subsequently, the Physiology Department at the State University of Iowa provided opportunity for use and further development of the experiments in two one-semester introductory courses.

The Sourcebook aims to help the laboratory instructor in first college courses in human physiology in three ways. First, it was prepared to present significant and practical experiments that can be done in most college physiology teaching laboratories. Secondly, it was designed to help the teacher prepare for laboratory work in such a way that satisfactory results be assured. Thirdly, the Experiments and related Considerations were organized to help the instructor to elicit reactions in the mind of the student to the ideas presented by the laboratory work in order to effect understanding of those ideas.

The Sourcebook lists thirty-nine experiments. For each experiment there is an introductory statement followed by Directions and Considerations. These are the parts of the text of the experiment to appear in the student laboratory manual. For the instructor there is provided, in addition, a statement of the Rationale of the experiment, a section dealing with Equipment, Materials and Methods and a section that includes a Discussion of the experiment, when such is necessary, and in every case the Responses to be expected from the student under the heading Considerations.

It is the consensus of those who have been concerned with the Sourcebook that its use has greatly increased the value of the laboratory work. Use of the Sourcebook has resulted in the situation that more of the teaching of the course centers around, or is related directly to, the concepts presented by the experiments.

Microfilm \$3.50; Xerox \$12.40. 271 pages.

**A COMPARISON OF THE EFFECTS  
OF HYPOTHERMIA ON THE ELECTRICAL  
ACTIVITY OF THE CEREBRAL CORTEX  
AND THE HEART OF THE CAT**

(L. C. Card No. Mic 60-5675)

James Albert Lipp, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor G. Edgar Folk, Jr.

The effects of hypothermia on the cerebral cortical electrical activity and heart rates of 16 cats were deter-

mined and compared. Two additional studies were undertaken in order to aid in the interpretation of the results, including: (a) the determination of the effects of hypothermia on the deep cerebral structures and (b) the effects of repeated inductions of hypothermia. The experimental procedure was designed to eliminate the non-physiological variables, such as drugs, in order that the direct effects of hypothermia on these systems could be determined.

The cooling procedure consisted of placing a restrained animal in crushed ice and utilizing hypothermia as the anesthesia. The electroencephalogram, recorded from implanted dural electrodes, was used as the index of cerebral activity while the heart rate was used to indicate cardiac activity. Core temperatures were recorded from the rectum.

The frequency, dominant voltage, and peak voltage of the cortical EEG decreased during hypothermia but the percent of decrease was small. There was a similar decrease in the electrical activity recorded from the deep cerebral structures. The heart rate exhibited a substantial decrease as the core temperature was reduced with the greater rate of decrease taking place during the early stages of hypothermia. The rate of depression of both the cerebral cortical electrical activity and heart rate was not altered by repeated exposures to cold which demonstrates the consistency with which these systems respond to hypothermia. Thus these responses can be more easily compared because of their stability.

The results showed that hypothermia had a greater depressant effect on the heart than on the brain; apparently the brain is more resistant to hypothermia. The reason for this is unknown but the brain contains the centers responsible for the resistance to hypothermia; the fact that these centers are protected in hypothermia fits homeokinetic theory.

Microfilm \$2.50; Xerox \$4.80. 95 pages.

**THE INFLUENCE OF TIME, CONCENTRATION,  
AND BILE SALT ON GLUCOSE ABSORPTION  
IN RAT INTESTINE, IN VITRO.**

(L. C. Card No. Mic 60-5690)

Arthur Sherman Nunn Jr., Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor Gordon W. Searle

Previous investigation in this laboratory had given indication that glucose absorption was in some manner inhibited by sodium taurocholate. To pursue this observation along lines that would give information concerning the mechanisms involved, a study has been made of glucose absorption velocities as a function of initial glucose concentration, time, and the presence of sodium taurocholate.

Three initial glucose substrate concentrations of 100, 200, and 300 mg% were used as mucosal solutions in isolated, everted segments, of rat upper small intestine. Each substrate concentration was studied for its particular effect on absorption rate at each of four time intervals (15, 30, 45, and 60 minutes). Each of these tests was repeated with the addition of 100 mg% bile salt to the mucosal solutions.



Absorption velocities at three initial concentration levels when analyzed by the Lineweaver-Burk method showed no change in  $V_{max}$  values for periods through 30 minutes. The observed small decrease in  $V_{max}$  beyond 30 minutes has been interpreted as evidence of an initial equilibration of glucose within the intestinal wall of *in vitro* preparations which gives abnormally high  $V_{max}$  values in the first 30 minutes. Consistent values for absorption  $V_{max}$  beyond 30 minutes indicate an independence from substrate concentration and time within the limits of this study.

Differences in absorption velocity ( $v$ ) were observed at 45 minutes between the different substrates under study. Absorption was significantly less for those segments starting with 100 mg% glucose than for those using greater initial glucose concentrations. This effect was more marked at 60 minutes. This was most likely due to glucose levels becoming reduced in concentration to a point of rate-limitation for the enzyme-substrate reaction.

Sodium taurocholate reduced the  $V_{max}$  values for glucose absorption in the experimental preparations. Analysis by the Lineweaver-Burk graphical method indicated this inhibition of the absorption rate was of a non-competitive type.

While for each time period the  $V_{max}$  for glucose absorption was decreased when bile salt was present, the  $V_{max}$  within the bile salt-free or the bile salt-present group did not appear to change importantly as a function of time. Microfilm \$2.50; Xerox \$4.40. 85 pages.

#### STUDIES ON PROGESTERONE METABOLISM IN NORMAL DAIRY COWS

(L. C. Card No. Mic 60-5174)

John Patrick Sullivan, Ph.D.  
University of Minnesota, 1960

Adviser: Alvin F. Sellers

Several attempts were made, using a variety of methods, to isolate pregnanediol from the urine of pregnant cows. The methods involved the use of acid and enzyme hydrolysis, removal of ketones as Girard derivatives, isolation of the carbinols as hemisuccinates, and separation of pregnanediol by adsorption chromatography on alumina. In no instance was pregnanediol found.

A method is presented in which the principle of isotope dilution is used for the chemical determination of progesterone in the peripheral blood of cows. The method involves extraction of the plasma, purification of the extract by partition between solvents, adsorption and paper partition chromatography, and quantitation by spectrophotometry.

The plasma progesterone concentration was determined in normal cycling cows on the day of estrum and on the sixth, twelfth, and eighteenth day after estrum. The concentration was found to rise from about 0.30  $\mu\text{g}/100\text{ ml}$  on the day of estrum to about 0.60  $\mu\text{g}/100\text{ ml}$  on the sixth day, and to return to about 0.30  $\mu\text{g}/100\text{ ml}$  on the eighteenth day of the estrous cycle.

Microfilm \$2.50; Xerox \$4.80. 92 pages.

#### STUDIES ON ELECTROLYTE DISTRIBUTION AND OSMOTIC REGULATION IN ISOLATED TISSUE SLICES

(L. C. Card No. Mic 60-4872)

Algernon Gordon Swan, Ph.D.  
The University of North Carolina, 1960

Supervisor: A. T. Miller, Jr.

Guinea pig liver and kidney cortex slices reacted differently with respect to changes in hydration when incubated under identical "optimal" conditions. (The so-called "optimal" conditions of incubation included an atmosphere of oxygen, a modified Krebs medium isosmotic with guinea pig serum and a temperature of 37°C.) The liver slices gained water and the kidney slices lost water. This response was the same whether the incubation started within two or three minutes after sacrifice of the animal or whether the tissues were kept for 30 minutes in a high-humidity, cold environment. The liver and kidney were approximately isosmotic with the serum immediately after removal from the living animal. There was a progressive increase in tissue osmotic concentration after removal from the animal, presumably due to autolysis. The increase in liver osmotic concentration was considerably greater than that of kidney.

The tissues gained water, sodium and chloride and lost potassium following incubation at 0°C in an atmosphere of nitrogen. This incubation condition was selected to provide minimal autolysis and maximum depression of the sodium extrusion process (sodium pump). The extracellular volume, as estimated by inulin space, became smaller while the intracellular compartment expanded. The tissues were hyperosmotic at the beginning of incubation with electrolytes accounting for approximately one-half of the total tissue osmotic concentration. The tissues were also hyperosmotic at the end of incubation; however, the increased osmotic concentration at this point was due largely to added electrolytes.

There were greater gains in water, sodium, chloride and a greater loss of potassium following incubation at 37°C in an atmosphere of nitrogen than in previous incubations (37°, O<sub>2</sub>; 0°, N<sub>2</sub>). This condition was selected to provide maximal autolysis and maximal sodium pump inhibition. The change in tissue osmotic concentration following this incubation was similar to that described above for the 0°/N<sub>2</sub> incubation. The liver extracellular volume (inulin space) increased, accompanied by a proportionately greater increase in the intracellular phase. Kidney swelling was entirely intracellular.

When incubated in hypoosmotic medium, the tissues swelled markedly. The liver swelling was predominantly intracellular, although there was an increase in the extracellular phase. The kidney swelling was entirely intracellular. This tissue osmotic concentration approached equilibrium with the hypoosmotic (100 mOs/l) medium by gaining water and losing electrolytes.

When incubated in hyperosmotic medium, the liver intracellular volume decreased and the extracellular volume increased, resulting in a slight increase in total tissue water. In kidney, the decrease in water content was again the result of intracellular change. The tissue osmotic concentration approached equilibrium with the

hyperosmotic medium (500 mOs/1) by losing water and gaining electrolytes.

From these observations it was concluded that:

1) guinea pig liver and kidney cortex are approximately isosmotic with guinea pig serum; 2) tissue osmotic concentration progressively increases after removal of the tissue from the animal and prior to incubation, due to autolysis; 3) an increase in tissue osmotic concentration due to autolysis is not an important cause of tissue swelling; 4) failure of the sodium pump is the main contributing factor in tissue swelling; 5) liver swelling is predominantly intracellular and kidney swelling is entirely intracellular.

Microfilm \$2.50; Xerox \$4.20. 80 pages.

#### HISTOLOGICAL AND BIOCHEMICAL DEMONSTRATION OF HYALURONIC ACID IN THE CENTRAL NERVOUS SYSTEM

(L. C. Card No. Mic 60-5317)

Irving James Young, Ph.D.  
University of Illinois,  
Chicago Professional Colleges, 1960

It has been demonstrated by means of HASE digestion, along with a stain supposed to be specific for acid \*MP, that an acid MP, presumably HA, is present in varying amounts in the perikaryon and is continuous with the axoplasm. Areas of the brainstem showed the presence of this material and though its presence was most marked in large pyramidal cells, all cells seemed to contain it. There was also present in the nucleus, nucleolus and mitochondria an acid MP which was not digested by the enzyme and was presumably a chondroitin, since chondroitins have been isolated from the CNS. In both embryos and adults the cytoplasmic material can be removed by HASE digestion. Both before and after HASE digestion PAS staining is present, particularly in the neuropil and this is unaltered by the enzyme treatment. The fact that PAS staining can still be found after the use of colloidal iron suggests the presence of other neutral MP in myelin, glia and "ground substance." Various other staining modifications, such as sulfation, enzyme digestion and procedural alterations themselves only serve to confirm the above impressions.

The presence of HA in the CNS was confirmed by the isolation of a MP from the brain. Characterization of the extract was made on several bases. Chemical determination of the hexuronic acid and hexosamine content and ratio, digestion of the material by HASE as demonstrated

chromatographically and spectrophotometrically, chromatography of acid hydrolysates of known HA and the brain MP, electrophoresis, crystal pattern and several other tests were used. All of them served to confirm the presence of HA in the CNS.

Attempts were made to study the MP under varying conditions. Chromatolysis and regeneration produced by section of the sciatic nerve revealed changes in the staining pattern and possible disappearance of the MP, both from the Nissl substance and the perikaryon in general. Early appearance of the MP in regenerating axons was also noted. Removal of HA in vivo was found by staining for the MP after repeated intracisternal injection of HASE. All other attempts to study the effects of HASE on the blood brain barrier and the passage of convulsant and sedative agents across it have been negative. In conjunction with this, attempts were negative in measuring the effect of enzyme on conduction in lobster giant axons and on spike potentials assayed by micro-electrode in frog dorsal root ganglia, immersed in HASE. Prolonged stimulation produced centrally by metrazol, picrotoxin, semicarbazide, methyl guanidine and strychnine and in peripheral nerve by electrical stimulation produced no histologic changes in the neurons or axons.

The conclusions are as follows:

1. The presence of HA has been effectively demonstrated in the CNS by biochemical techniques;
2. By means of a special stain and HASE its presence has been localized in the perikaryon, Nissl substance and axoplasm throughout the CNS;
3. Though present in early embryos, adults, regenerating neurons and nerve fibers, and though its removal from brain produced no obvious behavioral changes, attempts to disclose the role of this material in conduction or blood brain barrier remain essentially negative.

These negative results, however, should be viewed with caution because the literature is replete with information regarding viscosity changes, hormone effects and ion binding qualities of this substance.

\*The following is a list of abbreviations which have been used throughout the abstract:

CNS - Central nervous system  
HA - Hyaluronic acid  
HASE - Hyaluronidase  
MP - Mucopolysaccharide  
PAS - Periodic Acid Schiff

Microfilm \$2.50; Xerox \$4.40. 84 pages.



## POLITICAL SCIENCE

### POLITICAL SCIENCE, GENERAL

#### A COMPARISON OF THE DOCTRINES OF ST. THOMAS AQUINAS AND JOHN LOCKE ON THE RIGHT OF POLITICAL AUTHORITY

(L. C. Card No. Mic 60-5824)

Paul Mayhew Downing, Ph.D.  
Columbia University, 1960

St. Thomas Aquinas and John Locke both justify political authority by reference to a doctrine of right order. The dissertation studies each of these doctrines of order with respect to the causal relation upon which each is based, in order to compare more lucidly the consequent doctrines of authority.

The dissertation is divided into four chapters. Chapter I is a study of St. Thomas' doctrine of natural law, Chapter II of St. Thomas' doctrine of authority, Chapter III of Locke's doctrine of natural right, Chapter IV of Locke's doctrine of authority.

Chapter I. Natural law determines its subject to an order of ends (causes of being or goods) which he is to receive and become. The causal basis of natural law is the movement of the subject from potentiality to actuality given by an agent already in act.

Chapter II. Man is in society because he requires the assistance of others for the communication of causes of being which he must receive. The subject requires the assistance of others to complement his own limited agency in making physical things. More than this, he needs the communication of friendship in order to have fullness of being. The common good of society is the right order, as such, of the goods which society provides. This order is according to the natural law. The activities of the many, particular interests tend, of themselves, to cause disintegration of unity of order. Because unity of order is an object different from the object of particular interest, and because different objects are effected by different agents, a distinct agent is required to determine the parts of society to the unity of order. The right of political authority as such is, therefore, given by natural law; it is historically unconditioned, and independent of consent. Perfection of liberty consists in conformity of will with the objective order of good.

Chapter III. From Locke's denial of the efficacy of essence, his identification of good and evil with subjective pleasure and pain, his (inferred) affirmation of the causally active position of the mind or ego in experimental science, and his identification of freedom with coincidence of free choice and power of action, it is inferred that Locke's view of man is not that of man as subject of being (St. Thomas' view), but of man as maker. The first cause in the generation of natural right is the action by which a man modifies an external thing and thereby determines it to himself as property. Since the final object of the law of reason or nature is security of property and contract, this law must be a derivative of right, not its determinant.

Chapter IV. Consent is an exercise of property right. It is consent alone which creates authority as such, and the end of authority is to give security to private property, that is, to give effect to the law of nature. Hence, the right of authority is a derivative of property right.

Conclusion. According to St. Thomas, the object of the right order which justifies authority is an end to which the subject is determined. According to Locke, the object of right order is determined to the subject as its end. From these causally opposite doctrines of order follow quite different doctrines of authority.

According to St. Thomas, political authority, as a distinct agent, is required by the very order of society, because this order transcends the aggregate of particular interests. Locke, by his subjective doctrine of natural right, negated authority as an objective principle of society, and subordinated its exercise to private property right.

Microfilm \$2.50; Xerox \$7.40. 156 pages.

#### SOME BRITISH CONSERVATIVE THINKERS, 1930-1939.

(L. C. Card No. Mic 60-5825)

Arnett Alexander Elliott, Ph.D.  
Columbia University, 1960

The thesis is concerned with some of the tendencies in British conservatism during the inter-war period as they appeared in the thinking of four Conservative politicians - Harold Macmillan, Eustace Percy, L. S. Amery and Stanley Baldwin. As a whole, the thinking of the four men shows considerable diversity, but significantly, it reveals certain uniformities as well. The latter are important, because they constitute at least the rudiments of a conservative philosophy in a period of transition.

Each politician exhibits a markedly different style of thought. Macmillan, whose political future did not at that time appear to be particularly bright, was both an activist and a pragmatist, urging upon the party the adoption of radical schemes of economic and political reconstruction. Eustace Percy was deeply concerned with religious values and the whole of his political philosophy reveals this bias. L. S. Amery was the nationalist, *par excellence*, and his activities in behalf of the Empire as well as his reflections on government and politics may be explained to a considerable extent in terms of his nationalistic proclivity. Stanley Baldwin was the eclectic thinker and in him several political traditions are encountered. The analysis of Baldwin's thought consists largely of an account of the interplay among these separate intellectual traditions.

Notwithstanding their differences, however, the four Conservatives held certain attitudes and ideas in common. The similarities are more easily perceived in the writings of the first three - Macmillan, Percy and Amery. All

three are concerned with showing the inadequacies of both socialism and liberalism and attempt to chart a course between the two. (The title of Macmillan's most important book, *The Middle Way*, symbolizes this attempt.) Having rejected (in varying degrees) both the socialist and liberal traditions, these thinkers are confronted with the necessity of constructing a positive philosophy of politics and society. The efforts are by no means satisfactory, marred as they are by serious omissions, inconsistencies and throughout a lack of systematic thinking. Nevertheless, two key ideas emerge, which constitute the major contribution of these thinkers to the conservative thought of that period. These two ideas we may designate as corporatism and gubernaculum.

Corporatism, a term which the three thinkers themselves employed, is used to designate their concept of representation. Concretely, this concept was embodied in proposals for a third house of Parliament, which would represent various economic and occupational interests. In spite of the fascination of the third house idea, the three politicians revealed a lack of enthusiasm in mounting a sustained frontal attack against the traditional parliamentary system. However, there were other ways in which corporate interests could be represented. The most practical idea and the one most easily reconciled with British constitutional development was that which envisioned a more intimate relationship between interest groups and administration, including of course representation of these groups before and within the administrative system. It is at this point that the corporatism of Macmillan, Amery and Percy connects with Baldwin's idea of representation, for Baldwin was a vigorous exponent of the extension of the representative principle in administrative affairs. The advantage of the kind of approach advocated by Baldwin and others of like mind was that it appeared to be eminently practical and did not shock, as did the proposals for a third house of Parliament, the conventional outlook of the majority. More than that, Baldwin's idea was thoroughly rooted in historical reality, for the whole inter-war period saw the growth of formal and informal cooperation between representatives of economic and occupational interests and government administrators.

The second idea, which we have designated as gubernaculum, was accepted by all four thinkers. Essentially the idea was simply a plea for greater initiative by the executive and for a recognition of the importance of administrative discretion. The precise nature of the power of governance is explored, and the conclusion is reached that in the interpretation of the four thinkers, this power was conceived to be one of inspiration and integration, emphasizing the deft and guiding touch of government rather than coercion.

These two leading ideas constitute the nuclei of the particular strand of conservative thought which has been the subject of the thesis. Although the elements that make up this philosophy were not original, this school of conservative thought did fuse and mold these diverse materials into a product that it could fairly call its own. The development in political thought which the Conservatives actively fostered has become of increasing moment not only in Great Britain but in the United States as well. Part of its spreading appeal lies in the formula for securing political stability amidst a multiplicity of powerful groups. The Conservative "middle way" may offer the least unsettling prescription of available remedies for the growing pains

of a new society. Instead of individuals there are associations, endlessly negotiating with one another, leaving behind them a relational complex which will constitute the basic framework of the coming social order. Gently presiding over them all is the government, planning, encouraging and occasionally reproving. This vision, if not intoxicating, is at least soothing. In their present mood, the constitutional democracies of the West may find in this particular view of state and society the political philosophy they have been instinctively seeking.

Microfilm \$4.55; Xerox \$16.20. 356 pages.

#### THE IMPACT OF THE NEW DEAL ON GEORGIA POLITICS, 1933-1941.

(L. C. Card No. Mic 60-5132)

Roy Edward Fossett, Ph.D.  
The University of Florida, 1960

The inauguration of Franklin D. Roosevelt as President of the United States ushered in a new philosophy of the role of government in the United States. This concept of positive government posed many problems of adjustment within the federal system. These problems were present in every state, but in Georgia they were aggravated by the presence of a hostile state administration and by an institutional framework controlled by a strongly conservative rural-county "elite" composed of a "farmer-banker-merchant-lawyer-planter" combination. This is the story of how the New Deal came to Georgia. To gain acceptance it had to overcome many handicaps, and in so doing it made a lasting impact upon the state's political affairs and governmental structure.

The impact of the New Deal upon Georgia politics was determined by several factors. In the first place, it was confronted with an institutional framework based on a one-party system which, combined with various practices as the white primary, the county unit system, and the poll tax, had developed a narrowly constricted electorate and a meaningless politics based on personalities rather than issues. Restrictions on the suffrage deprived the New Deal of a large group of "natural" supporters since the Negro and large numbers of white sharecroppers, tenants, and laborers were by and large prevented from voting. In addition, the county unit system used to determine the winner in party primaries vested political control of the state government in the rural county "elite" whose interests were threatened by federal practices and requirements, and by the centralization of power in the state government and federal agencies.

The New Deal made little headway during the two administrations of Eugene Talmadge. The Governor was opposed to the philosophy and program of the New Deal and used all the authority of his office to oppose it. Talmadge was defeated in 1936 in a campaign based on participation in the New Deal program, and his highhanded activities in administering the state government. Although Talmadge had been defeated, the "elite" continued to control the state Legislature. As E. D. Rivers, Talmadge's successor, sought to implement his program, he was confronted with a Legislature which was at times lukewarm and at times openly hostile to him. Through the Legislature the "elite"



was able to hamstring Governor Rivers' program while at the same time paying lip service to the popular vote of 1936. The General Assembly hastened to pass enabling legislation to permit participation in New Deal programs, but balked at the more crucial point of financing state obligations under them. Because of this, the various social and welfare programs were always limited and inadequate in the state compared to other states, even some other Southern states.

The influence of the New Deal on Georgia politics during its first eight years should not be evaluated on the basis of results visible at the end of the period. Instead, an evaluation must lay more emphasis upon the later development of the seeds which had been planted. For one thing, it brought a reawakening of civic consciousness on the part of the tenant farmers and the Negro. For another, it shook from top to bottom the old agricultural establishment founded on the planter-tenant relationship. By shattering this relationship and by encouraging the migration from farm to city through crop reduction, it laid the basis for the industrial build-up of the state. Even though the political control of the "elite" had not been altered, the centralization of governmental functions was begun, with an accompanying trend to equalization of state services in all parts of the state. In general, the New Deal created a ferment on all levels and in all shades of opinion within the state. All of this worked toward laying the foundation upon which later Governors, notably Ellis Arnall, could build progressive measures which in 1937 were still considered too liberal and advanced.

Microfilm \$4.60; Xerox \$16.20. 357 pages.

#### THE CONSTITUTIONAL COURT OF THE GERMAN FEDERAL REPUBLIC

(L. C. Card No. Mic 60-5099)

John Charles Lane, Ph.D.  
Columbia University, 1960

This study deals with the jurisdiction, structure, and work of the Federal Constitutional Court and with its role in the West German constitutional system.

Established in 1951, the Court has been entrusted with a variety of functions. Notably, it has the power of judicial review of legislation, decides disputes between the Federation and the Laender and among the Laender, adjudicates legal controversies between component parts of the government, tries impeachments, rules on the constitutionality of political parties, and hears constitutional complaints (Verfassungsbeschwerden) from citizens who allege violations of their civil rights.

The Court is divided into two separate Senates each of which has a fixed share of the jurisdiction and is composed of ten (before 1956, twelve) judges. The two houses of the legislature each elect one half of the judges. Three of the judges of each Senate are elected from among the judges of other Federal courts and hold office during good behavior. The other judges are elected for eight-year terms, but are eligible for – and by past practice assured of – re-election. Political considerations have played a part in the election of judges, but all major political groups, geographical

regions, and religious faiths have been represented on both Senates of the Court.

Between 1951 and 1959 the Court received over 6,500 cases of which it decided more than 2,000 on their merits. Constitutional complaints resulting in decisions adverse to the plaintiffs accounted for over three-fourth of the cases. Several decisions of the Court greatly affected the Federal Republic's political and constitutional development, among them the decisions on the unconstitutionality of the Communist Party, on the validity of election laws directed against splinter parties, and on the constitutionality of the E.D.C. treaties.

Among the important principles of interpretation which the Court has adopted are those of the presumption of the constitutionality of legislation, of the non-justiciability of exercises of the treaty-making power, and – at least in its early decisions – of a "higher law" standard of judicial review. In several series of decisions the Court has developed a number of notable doctrines of substantive constitutional law on such matters as the rights and duties of political parties, the requirements of a fair trial, and the reach of the equality clause of the Constitution.

The jurisdiction of the Federal Constitutional Court, and the provision, unusual for Germany, that its decisions are binding on all other courts and governmental organs, give to the Court the opportunity of control over all branches of government. Most of its decisions will, furthermore, affect the interests and powers of individuals and of non-governmental institutions such as political parties and pressure groups. The affected parties have sought, in their turn, to influence the work of the Court, the election of its judges, or the conduct of litigation. Although the Court's decisions have occasionally caused disputes with other Federal courts and with the Federal government, no substantial reforms aimed at reducing the powers of the Court or at manipulating its membership have been effected.

Considerable criticism has been directed at some of the decisions of the Court, at such specific jurisdictional grants as the power to outlaw political parties, at the bifurcated structure of the Court at the parliamentary election of judges, and, more broadly, at the danger of judicial supremacy thought to be created by the existence of the Court. Such criticism has abated in recent years, and the place of the Court as a "Guardian of the Constitution" and as an integral institution of the West German constitutional system appears to be assured.

Microfilm \$4.05; Xerox \$14.20. 313 pages.

#### MAHATMA GANDHI'S CONTRIBUTION TO SOCIAL WELFARE IN INDIA – A STUDY OF THREE MAJOR PROGRAMS.

(L. C. Card No. Mic 60-5103)

Ammu K. Menon, D.S.W.  
Columbia University, 1960

This dissertation grew out of an increasing interest in understanding emerging social welfare programs in India in relation to Gandhian ideas, values and principles. This dissertation did not attempt to explore the relevance of



Gandhian ideas to the newly evolving profession of social work in India.

Gandhiji's political, social and economic influence on the Indian scene of the last three decades has been widely recognized, discussed and recorded. This study, therefore, is focussed on describing and analyzing his contribution to the field of social welfare specifically. Although it is difficult to quantify a variable like "contribution," an attempt has been made here to examine how far this contribution is felt in the programs dealing with the underprivileged Harijans (synonymous with the term untouchables, scheduled castes or depressed classes), unprivileged women, and the needy villagers.

It is essential to describe the social climate in which Gandhiji was born in order to understand the various factors that might have entered into his success and influence on the people. It has been necessary to look back before looking forward; the past helps to define both present and future.

The historical facts clearly show that the eighteenth and nineteenth centuries were periods of vigorous reform movements directed against the social ills that had crept into the life of the people. Such solid pillars of the Hindu society as the joint family, the caste and the village community (although they had stood the test of time for several centuries) started to show symptoms of breakdown. In addition to this impending collapse, the advent of British rule in India (1757 - 1947) introduced new ideas and new laws into the country, developing a new pattern of thinking among the people. Concepts of rationalism, democracy and liberalism became a part of current thinking during this period.

Prior to Gandhiji's arrival on the scene, a series of social reforms in the country successfully launched various movements. Many of them were able to reach groups of people at certain levels, but none of them succeeded in inducing changes at a mass level as did Gandhiji. Hence, the logical question is asked about the secret of his success.

Gandhiji's secret lay in his ability to identify with the masses. He was the embodiment of the Indian peasant. His simplicity of living and dressing appealed to the masses; to them, he represented the ancient tradition of India, especially renunciation and asceticism. Therefore they believed that he possessed a divine or spiritual gift. This gift was what Max Weber called charisma.

This power is an important tool in launching mass changes. The results of his charismatic leadership are seen in his many accomplishments. He condemned the practice of untouchability and appealed to the people to abolish this social evil. His contribution to Harijan welfare can be traced not only to his personal dedication but also to the fact that his ideas and activities were carried forward by public and private agencies and are still being carried out, particularly by the government of India, today. Article 17 of the constitution and the untouchability act of 1955 are outstanding examples of the effects of his influence.

Similarly, in the area of women's welfare, Gandhiji's frontal attack on the inferior status of women and his establishment of them as man's equal in the non-violent, non-cooperation and civil disobedience movements for political freedom enabled them to attain equality and offered them an opportunity to play an important role in the public life of the nation. Another advance for women's rights resulted from the core of the Hindu Code Bill which was passed into law by the first parliament of the Republic of India.

In the area of rural welfare the newly evolved and evolving programs of rural development are directly traceable to Gandhiji's insistent advocacy of the cause of India's downtrodden millions. Today many Indian villages are linked by a network of community development and National Extension Service programs.

All these factors add up to one important phase of social welfare history of India. Gandhiji was primarily a social reformer who worked hard to change the mode of thinking of the people, often involving the basic values of Indian society. He not only tried to show a way to the establishment of a new manner of meeting human needs by getting rid of the existing evils, but he also devised measures to prevent the recurrence of these evils. In other words, he demonstrated through his work that there are two distinct steps in all humanitarian movements. One gets at the cause and the other puts into effect the function. While he consistently worked for the promotion of the cause, he persistently inspired and prepared his followers to undertake the function. This function is now transformed into the routine of administration carried on by the government of India today in planning for the welfare of the people.

The goal of any reform must be translation into social welfare programs. This study reveals how Gandhiji provided, through his theory and practice, a necessary bridge between reform and welfare.

Microfilm \$3.80; Xerox \$13.30. 295 pages.

#### THE ROLE OF THE BUNDESRAT IN LEGISLATION IN THE FEDERAL REPUBLIC OF GERMANY

(L. C. Card No. Mic 60-4854)

Edward Lee Pinney, Ph.D.

The University of North Carolina, 1960

Supervisors: Charles Baskervill Robson and  
Andrew Mackay Scott

This study of the legislative role of the Western German Parliament's Second Chamber seeks to establish some empirical correlations between the structural habits of that body and traditionally accepted ideas about "upper" legislative houses. Although not intended as a comprehensive exegesis, a more or less thorough description of Bundesrat practices is obtained by examination and testing of the study's three major hypotheses.

The case method has been adopted. The hypotheses were tested against thirteen legislative histories that were selected on the basis of their presumed relevance for the point under examination.

Hypothesis one states that the Bundesrat is a body through which the separate interests of the individual German states are protected, and that state particularism is most effectively articulated in the Bundesrat. This hypothesis was validated, albeit with some qualification. The Bundesrat was demonstrated to be an active promoter of state interests generally against external intrusions, and at least a center for articulating the interests of individual states when those interests differ.

Because the Bundesrat has come to play an unexpected role in national party politics, attention was given to the extent to which state voting habits in the Bundesrat are



determined by the controlling party at the national level. The conclusion was reached that state particularism safely pursues its own course in the Bundesrat only when no strong motivation exists among the national political parties to achieve partisan conformity at all levels of decision-making. Consequently the federal consciousness of the Bundesrat is most conspicuous in those areas in which the political parties have no immediate interest.

The second hypothesis states that the Bundesrat is also an agency through which the specific points of view, and therefore the pressures, of the professional bureaucracy are brought to bear on federal legislation. Because the Bundesrat's standing committees are heavily staffed with career civil servants from the various states, this phase of the study was closely geared to the workings of the committees and to their relationship and influence with the plenary Bundesrat. This proposition was confirmed.

The second hypothesis was carried a step further, beyond examination of the overt exercise of influence by career members of state bureaucracies through the committees. The hypothesis-extension was validated to the effect that regular members of the Bundesrat as well, men who are politicians responsible to state legislative assemblies, tend to lean to a bureaucratic orientation in their discussions of legislative problems and issues. This was explained as resulting from the necessary concern of state executives with enforcement aspects of federal laws, which are administered for the most part by the separate states.

Hypothesis three, which failed of clear confirmation, posed the idea that the Bundesrat verifies for Germany the traditional axiom that Second Chambers exist to perpetuate the interests of conservative forces ineffectively represented in the popular houses. This hypothesis was not rejected, however, because some evidence existed to support it. It appeared likely furthermore that the unsupported evidence had no implicit relation to the concept of conservatism as defined.

Microfilm \$4.25; Xerox \$14.85. 329 pages.

#### POLITICAL SCIENCE, INTERNATIONAL LAW AND RELATIONS

##### ASSISTANCE TO TURKEY AS AN INSTRUMENT OF UNITED STATES FOREIGN POLICY, WITH EMPHASIS ON MILITARY ASSISTANCE: 1947-1955.

(L. C. Card No. Mic 60-5827)

James Madison Garrett III, Ph.D.  
Columbia University, 1960

Military assistance is only one of the instruments of national security policy employed by the United States in its power struggle with the Soviet Union. As such it competes for funds and scarce resources with other instruments. The allied armed forces equipped and trained through the military assistance program make possible the reduction of American forces, particularly ground forces, below those that would otherwise be required. In a sense allied armies are defending America's ramparts in Europe, Asia and the Middle East.

Turkey was one of the earliest recipients of American military assistance. Initially Turkish aid was almost entirely military in nature and the program as it has developed has remained predominantly military. Assistance was extended under relatively stable conditions. No serious political or social crisis has occurred, the domestic budget and the external payments were in balance when the program was undertaken, and Turkey, unlike Greece, has not been forced to defend herself against invasion or insurrection during the period of American assistance. For these reasons, and because the Turkish program, in contrast to the program of assistance to the Chinese Nationalist government, has never become an important issue in American politics, assistance to Turkey affords an ideal subject for a case study of a program of predominantly military assistance as an instrument of United States foreign policy.

Military assistance to Turkey has served the security interests of the United States by helping to deny a strategic area to Soviet encroachment, by demonstrating to other nations threatened by Soviet-inspired aggression the effectiveness of American assistance, and by illustrating to neutral nations the possibility of profitable close collaboration with the United States without compromising independence. The most significant contribution of the program to American security has been its part in the general policy of deterrence. Alliance through NATO, as well as more than one billion dollars in military assistance, has placed Soviet leaders on notice that the United States has a vital interest in Turkey. Large-scale military and economic assistance to and alliance with more than a score of nations, including Turkey, has served to demonstrate American determination to resist the expansion of Soviet power wherever practical and to underscore the American commitment to the defense of nations resisting Soviet encroachment.

The Turkish armed forces of 1947 were equipped with a variety of arms obsolete even by World War II standards. Troops were poorly trained and were led by officers who had not experienced combat in a quarter of a century. Troops and supplies moved on foot or by bullock cart. Military assistance of \$1,300,000,000 over a period of eight years resulted in the development of forces armed with American equipment of Korean War vintage and well trained in its use and in American tactical doctrines developed during World War II and the Korean War. Turkish forces nevertheless still exhibit serious weaknesses, notably in the fields of logistics and air defense.

Forces probably capable of defending Turkey against attack by Soviet satellites and of delaying Soviet conventional forces attempting to invade Turkey have been developed. Successful defense against a sustained Soviet attack or against bombardment by missiles or bombers has not been achieved.

Improvement in military posture has not been achieved without economic cost. Although Turkey received \$400,000,000 in economic assistance, including a nationwide network of roads suitable for military as well as commercial use, during the first eight years of military assistance, the combined impacts of the armament program, economic development, risky fiscal policies and inflationary pressures from external sources served to produce inflation in Turkey and a serious and sustained deficit in the balance of payments. To be able to industrialize Turkey must first rationalize agriculture in order to free labor in



significant numbers for industry. Otherwise, continued economic development and maintenance of effective military forces can be accomplished only by continuation of large-scale foreign assistance.

Microfilm \$4.15; Xerox \$14.65. 321 pages.

# THE KURDISH NATIONALIST MOVEMENT: ITS ORIGINS AND DEVELOPMENT.

(L. C. Card No. Mic 60-2606)

Wadie Jwaideh, Ph.D.  
Syracuse University, 1960

The aim of this study is to give an account of the origins and development of the Kurdish nationalist movement from the early part of the nineteenth century to the present. Two chapters are devoted to the geography, history, religion, literature and social organization of the Kurds, and are designed to provide the necessary background against which the study is presented.

The study proper begins with an account of the suppression of the semi-autonomous Kurdish principalities as part of a comprehensive scheme for the reorganization of the Ottoman Empire. Pertinent details are given with the object of presenting the interplay of the various forces at work. This is followed by a chapter on Shaykh Ubayd Allah, the precursor and model of a new type of Kurdish national leader. His ideas and political activities are dealt with at some length. An account of his rebellion in Turkey and his invasion of Persia is given in detail.

The Young Turk Revolution and Kurdish-Turkish relations form the subject of the following chapter. The first signs of the growing tension between the new Ottoman rulers and their Kurdish subjects are noted, while Kurdish discontent and Ottoman efforts to cope with it are discussed. In the following chapter, the Kurdish policy of Russia, Turkey's historical antagonist, is examined. The fortunes of the Kurds during the First World War are then described. The postwar period is treated in four chapters. The first of these deals with the situation in Turkey, Persia, and Syria, while the next three are devoted to the complex situation in Iraqi Kurdistan. The growth of Kurdish nationalist activities is examined at length in all four chapters, and the causes of Kurdish rebellions against the new British rulers in Iraq are discussed in detail.

Next the Kurdish rebellions of Shaykh Sa'id of Piran, of Aghri Dag and of Dersim in Turkey are dealt with, and the revolutionary activities of Khoybun, the Kurdish nationalist organization, are reviewed. The Barzani rebellions of 1931-1932 and 1943-1945 are discussed in two separate chapters. The new leftist tendencies of Kurdish nationalists which came to light during the latter rebellion are analyzed. The rise and fall of the Kurdish Republic of Mahabad is the subject of another chapter. Two significant developments, the increasing importance of leftist elements in Kurdish nationalism and the open support given by the Soviet Union to the Mahabad regime are covered.

The final chapter deals with the new extremist tendencies in Kurdish nationalism, Soviet support, the attitude of the Kurds toward the governments of the countries which they inhabit and toward the Western powers allied with these governments. It also deals with the ceaseless efforts

of the Kurds to gain the support of world opinion and to induce the United Nations to intervene in their favor. Finally, this chapter ends by discussing developments in Iraq since the July 1958 Revolution in that country and the close cooperation which followed in the wake of that event between Kurdish nationalism and Communism in Iraq and elsewhere. Microfilm \$11.65; Xerox \$41.60. 924 pages.

# POLITICAL SCIENCE, PUBLIC ADMINISTRATION

## POLITICS OF ADMINISTRATIVE REORGANIZATION IN MINNESOTA STATE GOVERNMENT, 1949-1959.

(L. C. Card No. Mic 60-5599)

Klaus Jacob Herrmann, Ph.D.  
University of Minnesota, 1960

This thesis purports to demonstrate the underlying causes as a result of which state administrative reorganization in Minnesota was rebuffed in the decade under discussion. The methodological approach to this subject has included research into the minutes of Minnesota's House Civil Administration Committee, numerous personal interviews with constitutional officers, legislators, state departmental executives, representatives of interest groups, and others. Further research embraced careful scrutiny of unpublished materials such as personal files of correspondence, state agency correspondence, and memoranda. Newspaper clippings, the legislative journals, and available literature on the broad subject of reorganization in books, theses, magazines, and other publications were liberally resorted to.

The fundamental hypothesis of this thesis is that administrative reorganization has failed of substantial achievement in Minnesota during the stated decade because of an informal combination of divergent components. This combination was comprised of state constitutional officers, state departmental and agency heads, state legislators, interest groups, and even to some extent the state supreme court.

The thesis is introduced by a brief history of the reorganization movement, and a presentation of conflicting viewpoints concerning the need for and the merits of an integrated system of administrative organization.

Then follow descriptions of the roles played by state constitutional officers in reorganization, on the parts acted out by the legislators, and on the involvement or concern exhibited by agency executives and special interest groups. Minnesota's Little Hoover commission, and the Minnesota Self Survey are examined as to their effect upon reorganizing state government.

The findings indicate justification of the original hypothesis. It is noted that among the factors which have militated against realization of administrative reorganization are the following: absence of a partisan legislature with a clearly defined and labeled Governor's Party; informal and effective cooperation among legislators, state agency heads, constitutional officers, and special interest



groups; the absence of any enabling legislation which would authorize gubernatorial implementation of reorganization subject to the legislature's veto; sometime gubernatorial indifference or lack of initiative in sponsoring administrative reorganization proposals. The role of Minnesota's Supreme Court in 1955 in invalidating that year's Reorganization Act is evaluated in terms of its political

ramifications. The major parties in Minnesota have given platform support in principle to administrative reorganization in the name of efficiency and economy, but in the absence of party organization within the legislature such support has been ineffective.

Microfilm \$4.50; Xerox \$15.75. 350 pages.

## PSYCHOLOGY

### PSYCHOLOGY, GENERAL

#### MATHEMAPHOBIA AND MATHEMAPHILIA: AN ANALYSIS OF PERSONAL AND SOCIAL FACTORS AFFECTING PERFORMANCE IN MATHEMATICS.

(L. C. Card No. Mic 60-4822)

Lewis Roscoe Aiken, Jr., Ph.D.  
The University of North Carolina, 1960

Supervisor: Lyle V. Jones

This investigation attempted to assess the contributions of selected intellectual and non-intellectual variables to success in college freshman mathematics courses. In addition, an attempt was made to discover the factors which determine individual differences in the non-intellectual variables. Although several etiological hypotheses were tested, the writer's major hypothesis stated that attitudes toward mathematics are largely determined by the specific pattern of reinforcement for mathematical learning to which individuals have been exposed.

A psychometric instrument of 20 statements, called the Math Attitude Scale, was constructed by the Likert attitude-scaling technique. The test-retest reliability of the instrument was .94.

The validity of the Math Attitude Scale was investigated in two ways. First, the partial correlation was determined between scores on the Math Attitude Scale and retest scores on the Mathematics Pretest for College Students, partialling out the effects of initial scores on the latter test. All subjects had taken their first college mathematics course in the four-month period between initial test and retest. Here, as elsewhere, the data were treated separately for the approximately one-hundred males and one-hundred females, and the significant partial correlation coefficients of .33 and .34, respectively, evidenced the validity of the scale. A second method of investigating validity was to assess the contribution of Math Attitude Scale scores to the multiple regression equation consisting of the other independent variates of average high school mathematics grades and scores on three Differential Aptitude Tests (DAT), with a criterion of final grades in freshman mathematics. For the female subjects, the Math Attitude Scale and the DAT Numerical Ability variable contributed significantly to the predictor equation. For the males, the Math Attitude Scale was not a significant predictor; average high school mathematics grade, DAT Verbal Reasoning, and DAT Numerical Ability were the significant variables.

Independent evidence for the validity of the predictor equations was obtained by the success with which they predicted the final grades of a distinct sample of students in a college algebra course.

The etiology of attitudes toward mathematics was also studied in two ways. First, Math Attitude Scale scores were correlated with scores on the seven scales of the Minnesota Counseling Inventory (MCI). Scores on the MCI Leadership and MCI Adjustment to Reality scales, for males and females, respectively, correlated significantly with Math Attitude Scale scores. However, when these two MCI variables were included in a regression analysis, together with the three DAT variables, they did not make significant contributions to the prediction of Math Attitude Scale scores. The second method of studying causes was to relate the Math Attitude Scale scores to the replies and scores on a questionnaire called the Intensive Personal Data Sheet. Significant relations found in this analysis were confined mainly to questions pertaining to the personalities of the subjects' former mathematics teachers and the subjects' previous scholastic experiences in mathematics courses.

It is concluded that attitude toward mathematics may be measured by the Math Attitude Scale and used for predicting achievement in mathematics. These attitudes are determined primarily by teaching methods in mathematics, although individual differences in general intelligence and temperament may affect the development of such attitudes. Evidence is also presented which leads to the conclusion that the female student, in contrast to the male, is motivated as much by non-intellectual as intellectual factors in mathematical learning.

Microfilm \$2.50; Xerox \$5.00. 98 pages.

**CHILDREN'S PERFORMANCE IN A SOCIALLY  
REINFORCED LEARNING TASK AS A  
FUNCTION OF TWO CHARACTERISTICS  
OF THE ADULT REINFORCER**

(L. C. Card No. Mic 60-5638)

Gerald David Alpern, Ph.D.  
State University of Iowa, 1960

Chairman: Professor Willard W. Hartup

The purpose of this study was to provide empirical data on the effects of sex of experimenter (physical sex and masculinity-femininity), sex of subject, and the interaction of these variables on preschool-aged children's performance on a socially reinforced learning task. Fifty-six Es and fifty-six Ss were employed in the study in order to permit a reliable determination of the interaction effects of sex of E and sex of S. The characteristic of masculinity-femininity (measured by a paper and pencil test) was included in order to extend the evaluation of the effects of E's sexuality on children's responsiveness to social reinforcement.

A revision of the Terman-Miles Masculinity-Femininity scale was administered to 200 male and 237 female undergraduates of the State University of Iowa. Individuals were selected from the extreme ends of the masculine-feminine distribution for their sex. Four groups of adult Es were constituted in this manner: Masculine-Males, Feminine-Males, Masculine-Females, and Feminine-Females. Equal numbers of male and female Ss from two preschools were randomly assigned to each of these subgroups.

Es were trained to use the social reinforcement procedures by means of a standardized procedure immediately preceding their session with S. Ss were brought to the experimental room by the investigator who then retired to an observation room.

After "warming up" S with two manipulative toys, E presented the experimental task. S's task involved dropping marbles into one of two boxes. One of the boxes was arbitrarily designated as "correct" for each S according to a counterbalancing procedure. When S dropped the marble into this box, he was verbally reinforced by E (e.g., "good," "that's fine"). When S dropped the marble in the "incorrect" box, E said nothing. After 45 such trials (and every subsequent 15th trial) Ss were given a choice by E to remain at the task or leave. The game was continued in the fashion described until S elected to leave or 90 trials were completed.

An analysis of variance of the number of correct responses over the first 45 trials for all Ss indicated that the reinforcement procedures effectively produced learning. Analyses of variance were employed to evaluate the effects of the sex variables on three performance measures: a) per cent of correct responses, b) number of trials to a criterion of six consecutive correct responses, and c) number of voluntary responses (i.e., all trials completed past the 45th trial). The three factors included in each analysis of variance were: a) Masculinity-femininity of E, b) sex of E, and c) sex of S.

The results of these analyses indicated that: a) male Ss performed with a greater per cent of correct responses and took fewer trials to criterion than female Ss; b) Ss took fewer trials to criterion when E was of the opposite

sex than when E was of the same sex as S; c) Ss persisted voluntarily in the learning task for more trials with masculine Es than with feminine Es. Each of these results was discussed in relation to the empirical findings of previous investigations. Microfilm \$2.50; Xerox \$5.00. 98 pages.

**RELIABILITY OF RESPONSES OF INCUMBENTS IN  
THE USE OF CHECK LISTS OF TASK ACTIVITIES**

(L. C. Card No. Mic 60-6091)

Harry Lloyd Ammerman, Ph.D.  
Purdue University, 1960

Major Professor: Ernest J. McCormick

Several forms of check lists of task activity statements were administered to job incumbents in three Air Force position types, with each airman being readministered an identical form one week later to determine their consistency in reporting various types of job information under varying conditions. Consistency of responses by each airman was measured by means of test-retest correlation of scale responses and by means of proportion of tasks consistently marked as performed on both administrations of the check lists. Such measures provided the basic data for several analyses of variance.

Important conclusions include the following:

1. The average test-retest reliabilities of incumbents in responding to several scales were: frequency of task performance ( $\bar{r}$ 's of .73 and .70 for two scales), length of task time ( $\bar{r}$ 's of .74 and .65 for two scales), relative proportion of total time per task ( $\bar{r}$  of .53), and general task difficulty ( $\bar{r}$  of .52).

2. The average test-retest proportion of agreement in reporting task occurrence was .72.

3. Consistency in reporting task occurrence is not generally related to consistency in reporting other types of task information.

4. A recall period of six months elicits more reliable task occurrence response than does a one-month recall period. One-month recall yields greater consistency of "time" and "difficulty" judgments than does six-month recall.

5. Interactions between various experimental factors were generally negligible. Factors were scales, recall periods, position and equipment types, and methods of response.

6. Consistency differences between position types do exist when measuring task occurrence and frequency. Some consistency differences also occur between equipment types within a single position type, on task occurrence and frequency scales.

Microfilm \$2.65; Xerox \$11.95. 202 pages.



**THE VARIABILITY OF WORK ACTIVITIES  
OF NAVAL PERSONNEL AS  
DERIVED FROM WORK DIARIES**

(L. C. Card No. Mic 60-6092)

Ronald Harold Asquith, Ph.D.  
Purdue University, 1960

Major Professor: E. J. McCormick

A study conducted to evaluate the use of work diaries, to analyze the work patterns of individuals, and to make certain recommendations about the utilization of work diaries.

Work diaries were administered to the personnel of the Combat Information Center on each of three ships of the U. S. Navy. The data were collected for periods of from five to fifteen days while the ships were at sea. Through the maintenance of these diaries, the incumbents indicated how their time was spent throughout a 24 hour period.

A summarization of the data provided descriptive information indicating the length of time worked by these individuals and the general work activities in which their time was spent. Statistical analysis of the data provided information about the variability of both individual and group work patterns.

It was concluded that a person's work patterns from day to day have a higher degree of similarity than do the work patterns of different individuals within a group on any one day. It was also found that while the collective work patterns of individuals do not vary significantly from ship to ship or from day to day, they do vary considerably from one rank/rate group to another; and supervisory personnel tend to perform their jobs with less variability in their work activities from day to day than do non-supervisory personnel.

It was further concluded that a five day period of diary administration would provide a highly reliable estimate of the collective work performed by a similar sample of subjects. Finally, this method, the utilization of work diaries, does provide adequate information which can be used to analyze the work patterns of many people simultaneously. Microfilm \$2.50; Xerox \$4.40. 83 pages.

**THE MEASUREMENT AND PREDICTION OF  
SUCCESS IN GRADUATE SCHOOL**

(L. C. Card No. Mic 60-4150)

Robert Orin Besco, Ph.D.  
Purdue University, 1960

Major Professor: Donald C. King

The purpose of this study was to investigate the relationship between various criteria of academic and research performance in graduate school and scores on the Aptitude Test of the Graduate Record Examination. 331 graduate students in the departments of Agronomy, Chemistry, Civil Engineering, Industrial Engineering, Pharmacy, Psychology, and Sociology were included in the investigation.

The criteria of success employed were grade point averages and faculty ratings. Paired comparison ratings of over-all performance and graphic trait ratings on the following variables were collected:

1. Knowledge of subject matter.
2. Imagination and originality.
3. Independence in work.
4. Motivation to succeed.
5. Ability to design research.
6. Ability to conduct research.
7. Over-all performance.
8. Readmission recommendation.

A new procedure for scoring paired comparison ratings was developed which involved fewer assumptions than previous scoring procedures. The modal response for each pair of ratees was used to determine the preferred rates of the pair. Modal responses were summed to obtain the final rankings within each department.

The rating variables and grade point averages were intercorrelated and factor analyzed using the centroid method of factor analysis. Only one general factor of performance in graduate school was disclosed. Correlations were computed between test scores and over-all performance ratings and the weighted factor scores to determine the validity of the test.

There were significant validity coefficients in every department except in one sub-section of the Psychology Department. The significant correlations ranged from .23 to .57.

It was concluded that graduate school performance as measured by these methods was unidimensional and that the Aptitude Test of the Graduate Record Examination would be a useful test to predict the general, over-all factor of graduate school performance.

Microfilm \$2.50; Xerox \$5.00. 100 pages.

**THE DIMENSIONALITY OF DISCREPANCIES  
BETWEEN SELF AND IDEAL CONCEPTS**

(L. C. Card No. Mic 60-5430)

Andrew James Edmiston, Ph.D.  
The Pennsylvania State University, 1960

This study represents a systematic inquiry into the discrepancies between the self and ideal self concepts as reported by a sample of college freshmen. The major purposes were: (1) to investigate the intra-scale variability in self-ideal image discrepancies among subjects with indices of concept discrepancy; and (2) to determine empirically the number and nature of the dimensions which would be found to group individuals according to their responses to a typical measure of self-regarding attitudes.

A pretested, modified form of a widely used self-descriptive rating inventory was administered to a random sample of 120 male, freshman college students. Three measures were obtained for each subject: the self-rating, the ideal self-rating, and the self-ideal congruence index. Using the magnitude of the congruence between the self and ideal self-rating measurement, 24 subjects with maximal concept discrepancies were selected for further analysis. The discrepancy responses obtained from the 24 subjects on each item of the self-descriptive rating



inventory were intercorrelated and the matrix of inter-correlations was then factor analyzed. The factor loadings possessed by all subjects on each factor were correlated with their discrepancy scores on each inventory item as a means of identifying the interpretive significance of each factor of discrepancy. By this process the five definable factors which emerged appeared to be explicable in terms of already propounded personality theory.

The results of the correlational analysis and the factor analysis were accepted as evidence which tentatively confirms the two hypotheses which guided the study. The findings of this study were discussed and an attempt was made to synthesize and clarify the relevance of the statistical data to the major issues under study. The five emergent factors were elaborated upon and suggestions regarding their nature and significance were introduced. The implications of these findings and their relationships to the broader theoretical and practical formulations of self concept theory were also suggested.

Microfilm \$2.50; Xerox \$5.20. 101 pages.

#### THE CONCEPT OF LOVE IN THE PSYCHOLOGY OF SIGMUND FREUD

(L. C. Card No. Mic 60-5303)

Vernon Carl Grounds, Ph.D.  
Drew University, 1960

Part I of the present study is devoted to "A Reconnaissance of the Problem." Covering a single chapter, it introduces the questions for which answers are sought.

(1) What is the status of love in the Freudian system? (2) How valid are the specific criticisms directed against Freud's understanding of love? (3) Does Freud helpfully illuminate the nature of love?

Part II takes up "The Psychology of Sigmund Freud," sketching his basic and evolving formulations. In chapter 2 his principles of theory-construction are dealt with as are the changes which his constructs underwent; the validity of his hypothesizing is evaluated; and his view of man's mental and emotional life is described as depth-psychology, dynamic, dualistic, and deterministic. From chapter 3 through chapter 7 the various aspects of that psychology are reviewed at length--the theories of psychic structure, unconscious mind, mental dynamics, instinct, sexual development. In short, an attempt is made to provide a fairly thorough exposition of Freudianism as a unique species of psychology.

Part III, which focuses on "The Freudian Concept of Love," embodies the most vital data in this study. Chapter 8, "The Nature of Eros," appraises Freud's contention that fundamentally love is an affect-state made possible by the sublimation of libido.

In chapter 9 "The Etiology of Eros" is reviewed. According to Freud, "the astonishing development" of love in human personality is a passage from autoerotism to secondary narcissism, culminating typically in object-love. The entire development is parentally influenced, in particular by one's mother.

"Eros and Genitality" comprise the theme of chapter 10. Here the sex-relationship between husband and wife a la Freud is portrayed. And a disillusioning portrayal it

is since a mare's nest of difficulties and complications makes mature, unambivalent love next to impossible.

"Eros and Culture" are discussed in chapter 11. Freud maintains paradoxically that eros is the creator of culture and that culture is the enemy of eros. From the historical perspective, culture is a sort of giant pyramid inverted upon the apex of an aboriginal ambivalence; *Totem and Taboo* shows how guilt, culture's invariable concomitant, has arisen. From the sociological perspective eros, defined as an integrating power, is the dynamic of community; it binds individuals to a common leader by aim-inhibited love as both military and religious experience demonstrate. But culture also opposes eros by demanding instinctual renunciation and by imposing not just repression but surplus repression.

Because Freud explains culture as the struggle between "Eros and Thanatos," chapter 12 rehearses the speculative journey by which this final formulation of instinct theory was attained; it also evaluates the arguments on behalf of this dichotomy of forces, the fusion and defusion of which allegedly decipher the riddles of biology and psychology --and perhaps, Freud suggests, even cosmology.

In chapter 13, "Eros and Analysis," evidence is adduced that, in spite of Freud's irritating equivocations, he sanctions this position: love in its widest sense is a major factor in neurosis and psychosis. Consequently, love is a major factor in therapy as well.

Part IV, "A Christian Critique of the Freudian Concept," is made up of a single chapter in which the data are summarized and some judgments essayed. That Freud recognizes the importance of love cannot be questioned in view of this study. To him it is of supreme importance as the principle which, together with thanatos, in unlocking the mysteries of psychology unlocks simultaneously the mysteries of biography, anthropology, sociology, history, and even, it would seem, cosmology. But it must be remembered that his theoretical formulations have been attacked at every point. Hence, because his ideas concerning eros are so inextricably enmeshed with his dubious speculations, the validity of Freud's love-concept is impugned. Furthermore, some of the criticisms directed against that concept--it is essentially sexual, irrational, pathological, ambivalent, penurious, and narcissistic--reveal that it is deficient and mistaken. And, finally, Freud leaves out of account the whole religious dimension of love, apart from which this human phenomenon cannot be adequately understood.

Microfilm \$6.10; Xerox \$21.60. 477 pages.

#### THE DEVELOPMENT OF A NON-VERBAL TACTUAL INTELLIGENCE SCALE FOR THE ADULT BLIND

(L. C. Card No. Mic 60-4180)

Walter Richard Jones, Ph.D.  
Purdue University, 1960

Major Professor: Dr. Joseph Tiffin

A research investigation in the development of a non-verbal intelligence test to assist in the prediction of vocational success with the adult blind.

The purpose of this research was to develop a non-verbal,



tactually administered, intelligence scale. The test was to be of use in assisting public and private agencies in the vocational rehabilitation of their blind clients.

Each item in the Vocational Intelligence Scale for the Adult Blind (VISAB) was comprised of four geometric figures; three of which were related to one another in some manner. The subject was asked to indicate orally which was the least related figure. The items were presented in a relief format with each figure approximately one and one-half inches in diameter. The final 43-item test resulted from two item analyses. Each analysis used both an internal criterion, total score on the VISAB, and an external criterion, score on the verbal scale of the WAIS. The test was administered to 626 legally blind persons between the ages of 20 to 50 years and free from any other major handicap. All subjects were allowed to use whatever residual vision they possessed while taking the test. The final scale had a mean score of 28.50, with a standard deviation of 8.05. The reliability, as measured by Horst's modification of the Kuder-Richardson formula #20, was .91.

The construct validity of the VISAB was demonstrated by computing the produce-moment correlation of the 43-item test score with the verbal scale score of the WAIS for 537 subjects; this correlation was .63. Four criteria of vocational success were utilized to measure the concurrent validity: (1) The ability to differentiate between major employment groups was measured by biserial correlations. The coefficient obtained in comparing the competitively employed ( $N = 135$ ) with the unemployed sample ( $N = 65$ ) was .49; and the competitively employed and sheltered workshop ( $N = 215$ ) groups yielded a .52 correlation. The test was not able to differentiate between the shop workers and the unemployed sample. (2) The criterion of gross weekly salary and score on the VISAB for 457 working subjects correlated .40. (3) A job hierarchy scale, designed to reflect the vocational achievement of the blind worker at time of testing, yielded a product-moment coefficient ( $N = 457$ ) of .41. (4) Five studies in sheltered workshops for the blind used supervisory ratings of job performance as the criterion. These correlations ranged from .42 to .69 for samples of size 11, 23, 31, 35 and 52. The ratings for the five studies combined ( $N = 152$ ) and the VISAB correlated .44, easily beyond the .01 level of significance.

Further findings revealed no difference between the sexes, but a significant difference ( $t = 6.66$ ) was observed between white and non-white subjects. The VISAB correlated significantly, -.17, with age. The sample was also divided into two visual groups, those with some remaining vision ( $N = 263$ ) and those with no useful vision ( $N = 274$ ). The biserial correlation obtained with the VISAB between these two groups was .09. A comparison of the validities of both the WAIS and VISAB with the criterion measures reveal the VISAB to be the superior predictor of job success among industrial workers. However, the WAIS yields a better estimate of the over-all vocational level of achievement.

The following conclusions seem justified by this research: (1) the test scores are reliable and have demonstrated sufficient validity in predicting vocational success; (2) the VISAB scores do yield a good measure of intelligence.

Microfilm \$2.50; Xerox \$4.60. 90 pages.

## AN ANALYSIS OF DIMENSIONAL JUDGMENT CONCEPTS

(L. C. Card No. Mic 60-5407)

Charles Nelson Uhl, Ph.D.  
University of Oregon, 1960

Adviser: Paul J. Hoffman

Conceptual behavior is asserted to be analyzable by means of a measurement scale model. Relations between categories of assignment employed in conceptual behavior exhibit properties equivalent to the properties of relations between categories of assignment of measurement scales. Dimensional concepts are those whose categories display the relation of ordering at least, and are equivalent to ordinal, interval and ratio scales. The term judgment is employed to refer to the fact that conceptual behavior is often probabilistic and often idiosyncratic. It is contended that the psychology of concepts almost exclusively has dealt with nominal concepts. The purpose of the present paper is to encourage extension of analysis to ordinal, interval and ratio concepts.

An information theoretic model is employed in an analysis of conceptual processes with particular emphasis on information transmission. The stimulus features of objects to be judged, the responses made, and the correct judgment classifications (criterion values) each may be quantified as to the amount of information conveyed. Relationships between the above information dimensions are treated as information transmission (referred to as  $T$ ). Three types of  $T$  are enumerated: (1) stimulus to response  $T$  (referred to as  $T_{s-r}$ ); (2) response to criterion  $T$  (referred to as  $T_{r-c}$ ); and (3) stimulus to criterion  $T$  (referred to as  $T_{s-c}$ ).

It is proposed that the requisite of successful concept learning is stimulus and criterion information. It is assumed that responses which deviate from criterion values tend to be replaced by responses which match criterion values during concept learning when stimulus and criterion information is available.

Three variables are selected for experimental investigation in a concept learning task. Predictions concerning the effects of each variable upon concept learning are offered. The variables and their associated predictions are: (1) a systematic sequential order of arrangement of stimulus objects in which only one of three stimulus dimensions varies in value from object to object (as opposed to a random arrangement of the same stimulus objects) will produce (a) lower errors of response, (b) a greater  $T_{s-r}$ , (c) a greater  $T_{r-c}$ , and (d) a greater willingness to continue at the task; (2) relatively high disparity of  $T_{s-c}$  among the three stimulus dimensions of each object (as opposed to relatively low disparity of  $T_{s-c}$ ) will produce more rapid reduction in errors of response; and (3) the intelligence of the individual concept learner will be correlated negatively with (a) errors of response and correlated positively with (b)  $T_{s-r}$  and (c)  $T_{r-c}$ .

A concept learning task is employed in which three stimulus dimensions of six values each represent an object to be classified. Stimulus objects (cards) are displayed one at a time. The criterion value of a card is announced immediately after the subject's response. Fifty-four cards comprise a learning series and twenty cards comprise a test series. Subjects are college undergraduates.



Experimental predictions 1a, 1b, 1c, 3a, 3b, and 3c are confirmed by the results. Predictions 2 and 3d are not confirmed at the required level of significance, although the results are in the predicted direction.

It is concluded that dimensional judgment concepts are amenable to experimental investigation, that they are learned, and that the systematic sequential order of arrangement and the intelligence of the concept learner facilitate this learning. It is suggested that a more complete range of disparity of  $T_{s-c}$  is necessary to assess the effect of this variable upon concept learning. Individual differences factors possibly related to concept learning are discussed. A number of possibilities for future research upon dimensional judgment concept learning and utilization suggested by the present investigation are discussed.

Microfilm \$2.50; Xerox \$5.80. 120 pages.

#### THE DEVELOPMENT OF A NEW ATTITUDE MEASUREMENT TECHNIQUE

(L. C. Card No. Mic 60-4221)

Norman Lee Vincent, Ph.D.  
Purdue University, 1960

Major Professor: Joseph Tiffin

A research problem in the development of a new attitude measuring instrument and the comparison of the new instrument with three traditional attitude measuring instruments.

The purpose of the present study was to develop an attitude scale according to the procedures outlined by Naylor and Vincent in a paper presented at the American Psychological Association (Sept., 1959) and to compare this scale with Thurstone, Likert, and Guttman scales in terms of internal consistency reliability and interval scaling characteristics.

A pool of 50 attitude toward unionism items was administered to a sample of 190 people; the same pool of items was sorted by 20 people on a Thurstone equal appearing interval scale. From the Thurstone sortings, which were highly reliable ( $r = .98$ ), a final Thurstone scale was developed; this scale consisted of 26 items that were spread along the entire range and that also had the least variability.

The sample of 190 people was randomly split into a primary group of 100 and a hold-out group of 90. Using the primary group and following standard item analysis procedures a 26 item Likert scale was developed. The 26 items retained for the Likert scale were the ones that were spread along the "difficulty" continuum and had the highest correlations with the internal criterion. Guttman's scalogram analysis was also performed on the responses of the primary group. The scalogram analysis resulted in a nine item Guttman scale with a reproducibility coefficient of .894 and a Plus Percentage Ratio of .71.

To develop the Naylor-Vincent scale intercorrelations ( $\phi$  coefficients) among the 50 items were computed using the responses of the primary group. A cluster analysis was performed on the intercorrelation matrix and 16 highly intercorrelated items were retained; these 16 items were pair compared by a new sample and scale values for the

items were computed. The reliability of the paired comparison ratings was .99 while the average discrepancy between observed proportions and theoretical proportions generated from the scale values of the items was .059.

Using the 90 papers in the hold-out group, matched halves reliability coefficients were computed and stepped up with the Spearman-Brown prophecy formula. Internal consistency reliability coefficients were .87 for the Thurstone scale, .91 for the Likert scale, .84 for the Guttman scale, and .82 for the Naylor-Vincent scale. If the Naylor-Vincent scale had as many items as the Thurstone and Likert scales the reliability would be expected to go up to .88. Thus the Naylor-Vincent scale compared favorably with the others in terms of internal consistency.

Because the paired comparison procedure allows for checks on reliability, consistency, and also tests on the validity of interval scaling assumptions, it is recommended that the Naylor-Vincent procedure is the one to follow in the development of an internally consistent attitude measuring instrument that meets the requirements of interval measurement. Microfilm \$2.50; Xerox \$4.80. 94 pages.

#### PSYCHOLOGY, CLINICAL

#### THE GOAL-SETTING BEHAVIOR OF CEREBRAL PALSY CHILDREN UNDER SUCCESS AND FAILURE CONDITIONS

(L. C. Card No. Mic 60-5183)

Wayne Rollin Ashley, Ph.D.  
The University of Oklahoma, 1960

Major Professor: Dr. Percy T. Teska

A great portion of the literature regarding the goals of the cerebral palsy individual is based on observations, speculations, and untested theorizing. This study was designed to determine experimentally whether the goals of cerebral palsy children differ from the goals of normal children under success, failure, or neutral experiences, to determine whether the presence of a pertinent handicap in cerebral palsy children results in goal-setting behavior different from that of cerebral palsy children with no handicap pertinent to the task, and to compare the effects of success, failure, and neutral experiences on the goal behavior of cerebral palsy and normal children. Four hypotheses were set forth to test these aforementioned critical areas of goal-setting in cerebral palsy children.

The observations of cerebral palsy children most frequently point to their lack of sufficient success and failure experiences and their lack of adequate interpersonal relationships. Lewin's theory of personality development offered a framework for these observations.

Selected as subjects were a group of 12 physically normal children, 12 cerebral palsy children whose physical handicap was not involved in performance of the experimental task (non-involved handicap group), and 12 cerebral palsy children whose handicap was involved in performance of the experimental task (involved handicap group). The subjects' age range was from 8 to 13 and IQ range was



from 75 to 132. The task utilized was a game in which the subjects threw a ball against a hidden movable backboard thereby receiving a fictitious performance score. The level of aspiration technique was employed, and fictitious attainment-discrepancy scores determined the subjects' reported scores. Each subject performed in 20 experimental trials under a success, failure, and neutral experience. The scoring systems employed were the Response Liability score, Shifts score, D-score With Sign, D-score Without Sign, and Goal Level total score.

No difference was found to exist in goal-setting behavior between normal children and cerebral palsy children under success, failure, or neutral conditions, and no difference was found in goal-setting behavior under success, failure, or neutral conditions between the non-involved handicap group and the involved handicap group of cerebral palsy children. Under the Response Liability and Shifts score systems a significant difference was found in the goal-setting of cerebral palsy and normal children between success and failure experiences, and under the Response Liability score system a significant difference was found between success and neutral experiences and between failure and neutral experiences.

The results led to the conclusion that separate theories of goal-setting behavior were not necessary for the normal and for the cerebral palsy child and that cerebral palsy children are sensitive to success and failure experiences in their goal-setting behavior.

Microfilm \$2.50; Xerox \$5.20. 105 pages.

#### FORM PERCEPTION AND READING RETARDATION

(L. C. Card No. Mic 60-4146)

Thomas Strand Ball, Ph.D.  
Purdue University, 1960

Major Professors: Edith Weisskopf-Joelson and  
Newell C. Kephart

The task of this investigation was to test the theoretical assumption that retarded readers of normal intelligence tend to be deficient in form perception and further, that they tend to utilize detail rather than form as a basis for perceptual discriminations.

The experimental population consisted of a group of twenty retarded readers matched in age, sex and IQ with a group of twenty children without reading difficulties.

The requirement of testing form perception in retarded readers posed some unique measurement problems. These problems arose from the fact that the conventional techniques for measuring form perception, e.g., Stanford-Binet Discrimination of Forms, seem not necessarily to require form perception but can be solved through a part-by-part matching process. Since it is believed that retarded readers tend to fall in this class, these tests may yield spurious results if used as measures of form perception. The question was whether or not retarded readers could perceive form at all, (by which is meant) at any time and under the most favorable conditions. Previously employed testing methods have used procedures that included additional variables. Among these variables are perceptual

speed, kinesthetic recognition and motor skill, abstract ability, the ability to detect minute variation in complex stimuli, to ignore distractions in the stimulus situation, to perceive under artificially restricted viewing conditions, to reproduce forms with materials that disrupt continuity, e.g., the Marble Board Test. Consequently, a major problem of the present study was to find a measuring instrument relatively free from these extraneous factors.

A measurement technique was selected based upon the phi phenomenon. The rationale for using phi as a measure of form perception was based upon a study by Orlansky (1940) who investigated the relationship between strength of phi and similarity and difference in form and spatial orientation of the stimulus-objects. Phi was strongest for identical stimulus combinations and weakened by variations in form or spatial orientation.

It was assumed that retarded readers relied primarily upon detail cues rather than form cues. From this it was predicted that (1) the perceptual effects of variations primarily in form would be relatively less for retarded readers than they would be for normal controls. Hence, in the phi test, the drop in threshold from stimuli involving identical squares to square and rectangle would be relatively less for these Ss than for controls. It was also predicted that (2) the perceptual effects of variations primarily in detail would be relatively greater for retarded readers than for controls. Thus, if the threshold for identical squares were compared with the threshold for straight-sided square paired with a wavy-sided square, the relative drop should be greater for the retarded readers than for the controls.

An analysis of variance revealed no differences between groups. These results led the experimenter to an examination of the experimental design, and a consideration of variables that had not been controlled. The most obvious of such variables was that of degree of retardation. The retarded readers' group was then subdivided into a group of severely retarded readers (2.7 years retarded) and another sub-group of mildly retarded readers (1.7 years retarded). For the mildly retarded readers' group the second analysis of variance confirmed the second prediction regarding the effects of detail variation. But this confirmation was qualified by the fact that degree of retardation as a control was not originally incorporated into the design. The results were suggestive but require further experimental verification.

Microfilm \$2.50; Xerox \$4.80. 91 pages.

#### NEED FOR AFFILIATION AND INTERPERSONAL EFFECTIVENESS

(L. C. Card No. Mic 60-4831)

Richard Nestor Carrera, Ph.D.  
The University of North Carolina, 1960

Supervisor: E. Earl Baughman

An empirical study was carried out in an attempt to explore some of the behavioral correlates of need for affiliation defined as a need for friendship or social acceptance. Need affiliation scores were broken down in terms of a positive-negative dichotomy depending upon



whether they reflected affiliative needs related to anticipation of the positive reward value of other people or affiliative needs related to a fear of social rejection.

Subjects were forty-eight male prisoners in their late teens and early twenties who volunteered to take part in a program of group psychotherapy conducted by the experimenter. The general procedure was to assign subjects to one of four groups on the basis of *n Aff* score and whether they were positively or negatively oriented. All groups were homogeneous on these two measures.

Dependent measures were popularity, accuracy of social perception, acceptance or rejection of fellow group members and a record of the pattern of communication in the therapy situation.

A general finding is the presence of an interaction between *n Aff* and type of orientation. Among negatives there is a trend toward an inverse relationship between *n Aff* and popularity. For positive the trend is reversed at a statistically significant level. Positive groups show no difference in group acceptance. For negative groups there is a significant tendency for high affiliators to be more rejecting than lows.

In accuracy of social perception there is no difference between the two positive groups. Among negatives the low affiliators are significantly more accurate than the highs.

In group therapy the high positive group is oriented toward the therapist while the low positive group shows an evenly distributed pattern of communication. Among negatives both high and low affiliators are focused on the therapist but the tendency is significantly greater for the lows. Findings are discussed and evaluated in the context of other data and the experimenter's impression as a therapist. Microfilm \$2.50; Xerox \$4.80. 94 pages.

#### THE EFFECT OF ORDER OF PRESENTATION ON PERCEPTION OF TAT PICTURES

(L. C. Card No. Mic 60-5225)

Adelaide Polizzotto Dollin, Ph.D.  
The University of Connecticut, 1960

The primary determinants of projective test responses have traditionally been assumed to lie within the personality of the subject. However, there is increasing attention being given to the idea that the subject's performance may be influenced by factors other than his personality. The present investigation was concerned with one of these factors, namely, with the effect of order of presentation on the perception of mood of TAT pictures. In Part I of the study the stimulus values of the cards with respect to mood were assessed. It was hypothesized that the cards have a definite stimulus value. In Part II the cards were administered to subjects in different orders to permit observation of the effect of changing contexts on mood ratings. The predictions were that judgments about mood would vary depending upon the mood of preceding cards and that the direction of changes in judgment could be predicted by assuming that, according to Helson's (1947) adaptation-level principle, a contrast effect would operate. Sad cards, for example, would be rated sadder when preceded by happy cards than when seen alone.

Fifty-one subjects, college volunteers, participated in Part I of the investigation. Each was presented with all 30 TAT cards in a different order and rated them on a five-point sad-happy scale. Analysis of variance revealed significant differences among cards as well as among subjects. Cards have a definite stimulus quality, their mood being, on the whole slightly sad. There was also evidence to suggest that simple ratings of the pictures yields substantially the same information on mood as ratings of TAT stories.

Seven each of the saddest, happiest and intermediate cards were selected for use in Part II. The seven cards of a given mood were administered as a group and considered one "treatment." The three treatments (H, happy; N, neutral; and S, sad) were presented to 120 subjects in one of six different orders: HNS, HSN, NSH, NHS, SNH, and SHN. Twenty subjects, 10 men and 10 women, were assigned at random to each of these order groups, and they rated the 21 cards for mood.

The hypothesis that judgments of the cards varies with order was confirmed. The direction of the changes in rating can be predicted by assuming that a contrast effect will operate. Sad cards were rated sadder when preceded by happier ones. Happy cards were rated happier when preceded by sad ones. Since the whole series of cards are actually slightly sad the most "neutral" cards were rated happier when preceded by the rest of the series. As a consequence of the relative sadness of the pictures, one might expect to find an adaptation to sadness when the standard series of cards is administered in the order prescribed by Murray (1943). Thus, cards seen near the end of the series should evoke happier stories than those seen earlier. The effect could probably be minimized in the clinical situation by noting the stimulus values of the cards and administering them in alternate happy-sad order.

#### References

- Helson, H. Adaptation-level as frame of reference for prediction of psychophysical data. *Amer. J. Psychol.*, 1947, **LX**, 1-29.  
Murray, H. A. *Manual for the Thematic Apperception Test*. Cambridge: Harvard Univer. Press, 1943.  
Microfilm \$2.50; Xerox \$3.60. 62 pages.

#### THE DISCREPANCY BETWEEN SELF-IDEAL SELF CONCEPTS AS NEEDS PROJECTED TO THEMATIC APPERCEPTION TEST PICTURES

(L. C. Card No. Mic 60-6106)

Harold William Faeth, Jr., Ph.D.  
Purdue University, 1960

Major Professor: Edith Weisskopf-Joelson

In this study the discrepancy between self concept and ideal self concept was construed as a deprivation state similar to other need states in its influence on behavior. Specifically the question asked was whether or not such discrepancies could be related to descriptions of figures in Thematic Apperception Test pictures for a variety of characteristics. Two major hypotheses were made regarding this general hypothesized relationship. These



were: (1) when a person wants to have more of a characteristic (ideal self concept) than he feels he does have (self concept), the discrepancy will be positively correlated with the amount of this characteristic ascribed to figures in the pictures of the Thematic Apperception Test; (2) when a person wants less of a characteristic (ideal self concept) than he believes he does have (self concept), the discrepancy will be negatively correlated with the amount of this characteristic ascribed to the TAT figures.

The subjects were 90 male psychiatric patients at a Veterans Administration hospital. All were previously screened to exclude those who had diagnosed brain damage. Subjects ranged in age from 23 to 52 years; formal education ranged from 8 to 16 years. The majority had the freedom of the hospital grounds. All subjects prior to the experiment were given the opportunity to refuse to participate in the research.

The basic test instruments used were the Edwards Personal Preference Schedule (EPPS) and pictures 4 and 7BM of the Standard Thematic Apperception Test series. The EPPS was used because it is composed of fifteen scales which are designed to measure a variety of hypothetical need states. A second reason for using the EPPS was that some control of the influence of social desirability on item choices is present. The EPPS was modified, with permission of the copyright holder, to measure self concept, ideal self concept, and the amount of each need ascribed to TAT figures.

The subjects were tested in groups of from 5 to 13, and for all forms, self concept, ideal self concept, and the ascribing of characteristics to the TAT figures. When describing the TAT figures, in the one picture given each of them, the subjects first wrote a story about their particular picture following simplified standard instructions. Immediately afterward they described the TAT figures by means of the modified EPPS. Each of the three testing sessions, in which the subjects completed one of the three test forms, was separated by at least a twenty-four hour interval. The subjects completed all three test forms; they were randomly assigned to one of six orders of test presentation. TAT pictures were also assigned randomly to the subjects.

The first hypothesis was not supported for either of the two need scales on which there were significant differences (at the five per cent level) between the self concept and ideal self concept. These two scales were for needs Intracception and Dominance; for each, the ideal self concept was greater than the self concept. The second hypothesis was supported by only one need, Abasement, at the five per cent level. This was the only scale on which the self concept was greater than the ideal self concept. These results were interpreted as providing weak support for the general hypothesis and the second major hypothesis.

The results were discussed with limitations and weaknesses of the study included. Suggestions for further research in the area delineated by the general question raised in this study were offered.

Microfilm \$2.50; Xerox \$7.40. 159 pages.

# AN ANALYSIS OF THE "PARIETAL SYMPTOM-COMPLEX" WITH SPECIAL REFERENCE TO THE GERSTMANN SYNDROME

(L. C. Card No. Mic 60-5654)

Max Leonard Fogel, Ph.D.  
State University of Iowa, 1960

Chairman: Professor Arthur L. Benton

## I. The purposes of this investigation were:

- (A) To determine whether the four behavioral deficits forming the Gerstmann syndrome are of unit rank, i.e., whether a single common factor can be postulated to account for the observed intercorrelations of the deficits, and;
- (B) If this single factor can be postulated for the Gerstmann syndrome, whether the same factor can be made to account for the observed intercorrelations of other symptoms which have been related to the "parietal-symptom complex."

## II. Assessment was made of the status of a number of these performances in a group of one hundred patients with disease or injury involving the cerebral hemispheres. The zero-order correlations and the second-order correlations (age and education held constant) among these performances were determined. The performances which were investigated were: finger localization, right-left discrimination, arithmetic calculation, writing, color cognition, color naming, visual memory (two tests), oral word fluency, picture interpretation, minute estimation, temporal orientation, reading comprehension, constructional praxis (three tests), and finger praxis (two tests).

Twelve interrelated analyses of these correlations were made. Eight of these were concerned with the elements of the Gerstmann syndrome and four with either the other fourteen tests or all the tests of the "parietal symptom-complex," including the Gerstmann performances.

## III. The findings were as follows:

- (A) Analyses of the intercorrelations among the elements of the Gerstmann syndrome indicated that the hypothesis of unit rank was tenable.
- (B) Analyses of the intercorrelations among the fourteen "non-Gerstmann" performances, when a composite variable defined by the Gerstmann performances had been partialled out, indicated that the hypothesis of unit rank was not tenable. Analyses of the intercorrelations among all eighteen performances of the "parietal symptom-complex," after a single common factor defined by all eighteen tests had been partialled out, indicated that the hypothesis of unit rank was not tenable.
- (C) Inspection of the tables of intercorrelations indicated generally positive intercorrelations among the test scores. Several performances correlated



as highly with the Gerstmann performances as the latter did with each other.

- IV. The results were interpreted to indicate that the hypothesis that a single common factor can be postulated to account for the observed intercorrelations among the performances of the Gerstmann syndrome is tenable. The results also indicated that the hypothesis that this factor accounts for all the observed intercorrelations of the "parietal symptom-complex" is not tenable. These main findings are neutral with regard to the question of whether the Gerstmann syndrome is a distinctive constellation of deficits, in the sense that the general factor found in it is confined to these deficits. However, inspection of the over-all findings suggests that the general factor found in the Gerstmann syndrome is not confined to it but extends to a number of other "parietal" performances. Indications for further investigation of this and related problems were discussed.

Microfilm \$2.50; Xerox \$3.00. 58 pages.

#### RELATIONSHIPS BETWEEN SELF-PORTRAYAL AND PSYCHOPATHOLOGY

(L. C. Card No. Mic 60-5266)

Daniel Gavales, Ph.D.  
University of Houston, 1960

The purpose of this study was to investigate relationships between the nature and accuracy of self-portrayal and type of psychopathology. Self-ratings were compared with clinical-ratings on the same population groups.

A total of 75 subjects were employed, divided equally among four psychiatric patient groups: obsessive, hysteric, character disorder, paranoid, and one non-patient group referred to as "normal." The patient groups were selected in accordance with Schafer's criteria of diagnostic character structure. Thirty-one six-point self-ratings scales designed to measure a wide range of personality characteristics were constructed and administered to each subject along with a standard battery of psychological tests.

Clinical-ratings were obtained by having examiners rate their respective subjects, using the same set of scale items. The agreement among clinical judges was determined by having the examiners blindly rate a series of test protocols selected from each diagnostic category. An arbitrary criterion of interjudge agreement was chosen.

Accuracy in self-portrayal was determined by calculating the discrepancy between the self and clinical ratings for each subject, employing only those items which passed the interjudge agreement criterion and which also yielded significant clinical-ratings.

A high percentage of the scale items yielded significant differences among the patient groups with regard to both self and clinical ratings. The nature of self-portrayal for each patient group was described with respect to the significant items. It was found that while the obsessive and hysteric patients were similar in presenting an unfavorable self-picture, the character disorders and paranoids rated themselves in a more favorable direction. Normals tended to be moderately favorable in their

self-portrayal. On the clinical-ratings the relative ordering of the psychiatric groups showed greater variability among items than it did on the self-ratings. Clinical-ratings of each group closely followed the criteria of psychopathology employed in this study.

The study demonstrated that while clinicians were able to significantly discriminate among groups on the more specific and easily measured items and on those related to criteria of psychopathology, self-ratings were much more discriminative than clinical-ratings on the more general and subjective characteristics such as those referred to as Self-Satisfaction variables. This finding was discussed in terms of the value of self-report data as a supplement to clinical evaluations. Some factors which may underly the process of self and clinical judgment were discussed.

The study revealed significant differences among patient groups with regard to accuracy in self-portrayal. The obsessives were the most accurate, the hysterics were next, then the character disorders, and least, the paranoids. These differences were discussed in terms of diagnostic character structure. It was found that normals were significantly more accurate than all of the diagnostic groups and more accurate than a carefully matched patient group. This finding was presented as additional support of the hypothesis that accuracy in self-portrayal is related to psychological health, while inaccuracy or distortion in the self-picture is associated with psychopathology.

Microfilm \$2.50; Xerox \$5.00. 99 pages.

#### SOME PSYCHOLOGICAL CORRELATES OF RECOVERY FROM SURGERY

(L. C. Card No. Mic 60-4541)

Donald Wayne Giller, Ph.D.  
The University of Texas, 1960

Supervisor: Dr. Ira Iscoe

There is general recognition that impending major surgery constitutes a stressful situation for the individual. However, as yet, but meager attention has been devoted to this area by psychologists interested in reactions to stress. The present study concerned itself with the feasibility of employing relatively brief objective psychological measures to predict recovery from surgery.

Fifty white males all awaiting major surgery were administered both pre- and postoperatively the following psychological measures:

- The K Scale, derived from the MMPI
- The Ego Strength Scale, constructed by Barron, using MMPI items
- An Attitude Towards Surgery Scale
- A fear of Surgery Report

These measures constituted the independent variables. Relevant biographical and historical information was also obtained. Criteria for recovery from surgery were as follows:

- The number of pain reducing and sleep inducing medications received during the first five post-operative days. This served as the main criterion.



- b. The total number of pain reducing and sleep inducing medications received during the entire postoperative period in the hospital
- c. The total number of days spent in the hospital post-operatively
- d. Nurses ratings of recovery
- e. Global chart ratings of recovery

These measures constituted the dependent variables.

### Results

- a. A statistically significant ( $p < .01$ ) multiple correlation was obtained between the independent variables and the main criterion.
- b. The Ego Strength Scale accounted for most of the predictive ability of the independent variables, the remaining measures serving to increase the predictive value.
- c. A search for possible combinations of scores on the independent variables failed to group enough cases within any combinatory framework to justify proper statistical treatment.
- d. A significant negative correlation ( $p < .05$ ) was obtained between the Attitude Scale scores and the total number of days spent in the hospital following surgery.
- e. Patients receiving general anesthesia reported significantly greater amounts of medication than did spinal anesthesia patients. These two groups, however, did not differ on a measure of Ego Strength.
- f. There were no significant relationships between biographical and historical data on any but one of the independent or dependent variables. Ss who had experienced combat in service reported a significantly lower degree of fear of impending surgery than did Ss with no combat experience.
- g. Of the independent variables, only the Attitude Scale showed a significant shift in the re-test situation and this was to a more "positive" attitude towards surgery.
- h. Nurses ratings and global chart ratings were significantly correlated with the main criterion but unrelated to any of the independent variables.

### Conclusions

- a. Extreme differences exist with regard to recovery from surgery.
- b. The surgical ward is felt to constitute an appropriate "laboratory" for investigation of response to stress.
- c. Brief objective psychological measures for predictive purposes under the conditions of the present study appear feasible. A measure of Ego Strength would seem to be highly desirable.
- d. The problem of the validity and reliability of adequate criteria measures is a most crucial one for future studies.
- e. Maintaining reality based perceptions of events around him appears to be a problem for the surgical

patient and one in which the doctor-patient relationship plays a major role. Findings in this study agree with previous results.

- f. The lack of relationship between degree of expressed fear and the main criterion measure for recovery is at variance to previous findings.
- g. Future studies should take into account many variables within surgical groupings deemed important to more precise investigation. Implications for further research were discussed and it was recommended that broader, more intensive interdisciplinary studies be conducted utilizing all data conceivably appropriate to this complex area of human behavior.

Microfilm \$2.50; Xerox \$5.20. 102 pages.

### THE EFFECTS OF NEED FOR ACHIEVEMENT, ACHIEVEMENT IMAGERY AND TEST ANXIETY ON ARITHMETIC PERFORMANCE.

(L. C. Card No. Mic 60-5662)

Barbara Behrens Hills, Ph.D.  
State University of Iowa, 1960

Chairman: Professor I. E. Farber

The purpose of the present study were (a) to examine the interrelations among two measures of achievement motivation, the Mc Clelland n Ach scores and the Iowa Picture Interpretation Test AI scores and test anxiety, and (b) to examine the effect of achievement motivation and test anxiety on arithmetic performance.

Scores on the Iowa true-false form of the Test Anxiety questionnaire as well as n Ach and AI scores were obtained for 281 college undergraduates, including 153 men and 128 women. The criterion score was the number of correct arithmetic problems completed during six trials of simple three digit addition problems.

There was a small positive correlation for men between n Ach and TA. Although the magnitude (.166) of the correlation was not large, it was in the direction suggested by Alper (1953) and Mandler and Sarason (1952), indicating that persons with high achievement needs are more likely to be anxious in achievement situations than those with low achievement needs. There was no significant relation between AI and either TA or n Ach.

The Lo TA Ss solved more arithmetic problems than Hi TA Ss. For men there was a small but significant negative correlation (-.169) between TA and arithmetic performance. There was also a negative correlation between TA and arithmetic performance for women but it did not reach statistical significance.

The study failed to demonstrate any reliable relation between either of the achievement measures, n Ach or AI and arithmetic performance. There was a significant ( $p < .01$ ) relation between composite scores on college entrance examinations and arithmetic performance. When Ss were matched on the basis of their college entrance scores, there still was no difference between Hi and Lo n Achievers or between Hi and Lo AI Ss. A significant sex

difference was obtained, with men consistently solving more problems than women.

For the  $n$  Ach test, the mean correlation of scores on one slide with the combined scores on the other three slides was .154 for men and -.063 for women. Spearman-Brown corrected odd-even coefficients for the AI scale were .65 for the men and .54 for women. It appears that one important prerequisite to further study in this area may be the development of more reliable test measures.

Microfilm \$2.50; Xerox \$5.00. 97 pages.

**THE CALIFORNIA PERSONALITY INVENTORY  
FLEXIBILITY SCALE, MOTIVATION  
INSTRUCTIONS, AND SOME  
MEASURES OF BEHAVIORAL RIGIDITY.**

(L. C. Card No. Mic 60-5663)

David Allen Hills, Ph.D.  
State University of Iowa, 1960

Chairman: Professor Leonard D. Goodstein

This investigation sought to incorporate three lines of previous rigidity research--rigidity as a generalized response tendency, a personality test concomitant of rigid behavior, and the relationship of motivational instructions to rigidity. Two criterion tasks were used--the Mirror Tracing task and the Stroop Color Naming Test--to determine whether or not  $S$ s who were rigid in performing on one of the tasks would also be rigid in performing on the other task. The flexibility-rigidity personality dimension was introduced through selection of  $S$ s in accordance with their responses to the Flexibility ( $F_x$ ) scale of the California Personality Inventory (CPI). The motivation variable was manipulated through instructions offering small cash bonuses for "superior performance."

From a large pool of undergraduate introductory Psychology students, 120 men and women whose CPI  $F_x$  scores fell within the upper or lower 25 per cent of the total distribution of  $F_x$  scores were selected. These  $S$ s were then individually administered the Ishihara Color Blindness Test as a control for color blindness, and the two criterion tasks, the Mirror Tracing task and the Color Naming Test. Thirty flexible (high  $F_x$ ) and 30 rigid (low  $F_x$ )  $S$ s were assigned to the group which received incentive instructions and the opportunity to win small cash bonuses by their performance. The remaining 60  $S$ s comprised the control group which received neutral instructions only. Group assignment was randomly determined except that an equal number of men and women were included in each of the groups.

The results failed to support the conclusion that rigid behavior as defined by the Mirror Tracing task and the Color Naming Test has meaningful generality. The between subgroup variability in the correlation coefficients was large and suggested that no dependable interrelationships exist between mirror tracing and color naming performance.

For the most part, the flexible  $S$ s as defined by the CPI  $F_x$  scale did not perform these tasks more adaptively or effectively than did the rigid  $S$ s. There was a significant interaction between  $F_x$  scores and the sex of the  $S$ , with flexible women performing more proficiently than rigid

women on the Mirror Tracing task, but with flexible men performing less proficiently than rigid men. Thus, the CPI  $F_x$  scale did not appear to be a useful predictor of rigidity or inflexibility as defined in this study. A slight positive relationship between the  $F_x$  scale and intelligence was found; but, since there appeared to be no relationship between intelligence and the performance measures, this confounding did not appear to alter the interpretation of the results of the present study.

Although incentive instructions tended to be associated with more rigid performance than neutral instructions, a statistically significant difference was shown only with color naming errors as the measure. Reasons for the relative ineffectiveness of the motivation variable were discussed.

The implications of these results and previous investigations are that rigidity has, at present, limited usefulness as a concept. It would seem that the term "rigidity" should be used only in a general, descriptive sense since what appears to be similar "rigid" behavior may have a variety of determinants including the nature of the task and the sex of the  $S$ . Microfilm \$2.50; Xerox \$4.20. 79 pages.

**TEMPORAL VARIABILITY AND PRE-MORBID  
ADJUSTMENT IN SCHIZOPHRENIA**

(L. C. Card No. Mic 60-5136)

Charles C. Humphries, Ph.D.  
The University of Florida, 1960

High variability has been one of the most consistently demonstrated characteristics of the performance of schizophrenics. This present experiment proposed that variation in psychological test performance was related to pre-morbid adjustment in schizophrenia, the individual with a good pre-morbid adjustment showing more temporal variability than the individual with poor pre-morbid adjustment.

The subjects used in this study were 60 male schizophrenics, all between 19 and 35 years of age and none had been hospitalized for more than five years. They were rated for pre-morbid adjustment by the use of Part I of the Phillips Scale, which measures five aspects of pre-morbid social and sexual adjustment.

The Wechsler Memory Scale, the Pursuit Rotor test, the Word Association Test and the Digit Symbol test were presented individually to the 60 subjects every two weeks for a period of six weeks, making a total of four presentations altogether.

All raw scores were converted into deviation scores, and variabilities computed from them. Variabilities of the seven subtests of the Wechsler Memory Scale and each of the other tests used were correlated with Phillips Scale scores. Also the total variability for each subject on all the tests combined was correlated with Phillips Scale scores. With the single exception of the Pursuit Rotor test, all correlations between variability and pre-morbid adjustment were not significant.

It may be concluded from these results that the high temporal variability found in schizophrenics is not a function of pre-morbid adjustment.

Microfilm \$2.50; Xerox \$3.00. 54 pages.



# THE EFFECTS OF INTERPERSONAL INTERACTION UPON THE TASK PERFORMANCE OF CHRONIC SCHIZOPHRENICS

(L. C. Card No. Mic 60-5094)

Marvin Hunter, Ph.D.  
Columbia University, 1960

The purpose of this study was to examine the task performance of chronic schizophrenics in interactional situations of differing interpersonal intensities. The theoretical impetus was provided by the position that schizophrenia is an interpersonal disorder and the symptomatology a reaction to events in the social environment.

The two independent variables were four experimental social conditions and the mental status of the subjects. The dependent variables were measures of task efficiency on the Kohs block designs and responses to a standardized post experimental interview schedule.

The mental status variable was defined by three groups of subjects; regressed chronic schizophrenics; partially remitted chronic schizophrenics; and a normal control group of hospitalized tuberculosis patients. Chronicity was defined as more than two years of continuous hospitalization. The regressed group was characterized by more severe symptomatology than the partially remitted, and were roughly equivalent to the description generally given to the "deteriorated" patient. Each group consisted of 32 Caucasian male subjects; a total N of 96. All subjects were equated for age and education. Each subject participated in only one of the four experimental conditions since a matched subjects design was utilized.

The dependent measure of performance consisted of the number of blocks placed correctly to duplicate a design within time limits (task efficiency). The task materials consisted of a set of 16 Kohs blocks and a series of 14 block designs of increasing complexity.

The interpersonal variable consisted of 4 experimental social conditions of increasing interpersonal intensity. The first two conditions were designed as essentially non social conditions; and the second two as social conditions, requiring interaction with a peer. In three of the four conditions a confederate was utilized to portray the role of a subject. By this device, the experimenter had complete control over the nature of the interaction and the performance of the task.

The hypotheses predicted that as the interpersonal intensity of the experimental conditions increased, the task efficiency of regressed schizophrenics would decrease more than the task efficiency of the partially remitted, whose task efficiency would decrease more than normals.

The results supported the major hypotheses. Regressed schizophrenics were more disrupted by the social conditions combined than the partially remitted group, who were more disrupted than normals.

The task efficiency of the regressed group significantly decreased as the intensity of the interpersonal conditions increased. Their performance was clearly less efficient in the two social conditions combined than the two non-social conditions combined.

The performance of the partially remitted group did not show the clear decrease that was seen in the regressed group, but their task efficiency was significantly lower in the social conditions combined than in the nonsocial conditions combined.

The normal group showed no significant differences among conditions.

The basic assumptions with which this research started are given substantial support by the experimental findings. It was shown that the performance of schizophrenics disrupts in conditions which require intense interaction with another person. In addition, it was shown that the "most deteriorated" patients are most disrupted by interaction with others.

These findings have posed the new problem of more clearly specifying the exact nature of the disrupting stimuli in interactional situations. In addition, the question of whether chronic schizophrenics are characterized by greater anxiety than normals or by the same amount of anxiety but less constructive modes of dealing with it was posed by the results.

Finally, the position that some symptomatology in schizophrenia may be related to events in the social environment has been supported by the results of this experiment.

Microfilm \$2.50; Xerox \$5.20. 102 pages.

## DISCREPANCIES BETWEEN SELF-CONCEPTS AND IDEAL SELF-CONCEPTS IN PARANOID SCHIZOPHRENICS AND NORMALS

(L. C. Card No. Mic 60-5237)

Bertram Patterson Ibelle, Ph.D.  
The University of Connecticut, 1960

### Purpose of the Study

The purpose of the study was to show that: (1) defensiveness on the part of seriously maladjusted individuals could lead to discrepancies between self-concept and ideal self-concept, as measured by the Q-sort self-ideal correlation coefficient, that would be indistinguishable from the discrepancy between self-concept and ideal self-concept displayed by normals; and (2) that defensiveness of sufficient intensity to result in these spuriously optimal self-ideal discrepancies could be predicted for identifiable groups of individuals on the basis of established personality theory.

### Delimitation of the Problem

The study was limited to a comparison of the Q-sort behavior of paranoid schizophrenics and normals.

### Procedure

The study followed the ex post facto design. Thirty paranoid schizophrenics (fifteen males and fifteen females) were randomly selected from a pool of potential subjects who could satisfy the requirements of an operational definition of paranoid schizophrenia. Thirty individuals (fifteen males and fifteen females) who could meet the requirements of an operational definition of normality were selected to serve as a normal control group. A seventy-four item self-concept Q sort was administered twice to each subject. On the first sort, the subject was asked to describe himself as he was at the moment (self-sort). He was then asked to re-sort the items in terms of the way

he would like to be (ideal self-sort). The Pearson correlation coefficient was then determined to show the degree of correspondence between the self-concept and ideal self-concept. Prior to comparing the performance of the two groups on the Q sort, it was shown that the groups did not differ on the variables of intelligence, age or education. The male and female paranoid schizophrenics did not differ on the variables of months spent in hospitals or months since first hospitalization for a psychiatric disorder.

### Findings

*t* tests revealed no significant differences between the means of the arrays of Q-sort self-ideal correlation coefficients obtained from the paranoid schizophrenic and normal groups. No differences were found between the means of the various subgroups (male and female paranoid schizophrenics, male and female normals). Analysis of variance showed no differences based on diagnosis or sex and the effect of interaction between diagnosis and sex proved negligible. Analysis of covariance revealed no differences between the adjusted means when intelligence or education were controlled.

### Conclusions

(1) With at least one well defined group (paranoid schizophrenics), the magnitude of the discrepancy between self-concept and ideal self-concept, as measured by the Q-sort self-ideal correlation coefficient, will not give an adequate reading on the state of an individual's psychological health.

(2) The use of the self-ideal discrepancy as a sole and definitive criterion of need for psychological or psychiatric help is not warranted.

(3) Rather than being a clear-cut measure of psychological health, the results of this study suggest that the Q-sort self-ideal discrepancy may be an excellent indicator of the effectiveness of an individual's self-system in maintaining unacceptable aspects of the self in a state of dissociation and thus protecting the individual from experiences of severe anxiety and feelings of self-dissatisfaction.

Microfilm \$2.50; Xerox \$5.40. 109 pages.

### THE RELATION OF ELECTROENCEPHALOGRAPHIC SLOWING TO THE IMPAIRMENT OF SELECTED INTELLECTIVE FUNCTIONS

(L. C. Card No. Mic 60-4843)

Carlyle David Jenkins, Ph.D.  
The University of North Carolina, 1960

Supervisor: W. Grant Dahlstrom

This study explores relations between two widely separated levels of brain function: the electrophysiological and the behavioral. A review of the literature revealed difficulties with research depending on anatomic estimation of brain damage, and pointed to the electroencephalogram (EEG) as having advantages for estimating scope and intensity of brain dysfunction. Speed of wave activity (frequency) emerged as the EEG variable most clearly

associated with observable behavior. It was hypothesized, therefore, that regularity and speed of electrical activity in the brain, as recorded by the EEG, is associated with optimal expression of intellectual abilities. Conversely, slowing and irregularity of brain potentials would be accompanied by corresponding degrees of impairment of these functions.

The overt behavioral variable, intellectual function, was measured using the following tests: Wechsler Adult Intelligence Scale, Porteus Mazes, Revised Benton Visual Retention Test, and a Weight Discrimination Task (Stanford-Binet, 1916).

A rating scale was developed which reliably categorized the EEG records on the basis of relative proportions of alpha, beta, theta, and delta waves. These ratings were made by clinical judgment of the complete eight-channel EEG tracings. The sample included 57 subjects between the ages of 18 and 64, of both sexes, from medical, neurological, psychiatric and surgical wards of two hospitals. All were sufficiently alert and motivated to complete the test battery. Previous studies had made clear the importance of maintaining homogeneity within EEG groups. To assure this and to make unidimensional analysis of the EEG condition possible, only individuals with non-paroxysmal, non-lateralized, and non-focal abnormalities were included in the sample. The subjects, allotted to eight categories of the EEG Rating Scale, were combined into four major groups for statistical analysis. The groups were comparable in age, education and socioeconomic status (occupational rating).

With EEG rating as the independent variable and education as the control variable, two-way analyses of variance were computed, with test scores serving as the dependent variables. The analyses showed association between EEG slowing and lower scores on the following tests (statistical significance of *F* in parenthesis): WAIS Performance IQ (.01), Digit Symbol (.05), Block Design (.005), and Object Assembly (.005) subtests, Porteus Quality Score (.05), Benton Visual Retention Test (Number correct, .01; Error score, .005), and Weight Discrimination (.005). The Porteus Test Quotient showed marginal significance. All the tests given tended to show some decrease in scores among patients in the most pathological EEG category, but in none of the WAIS Verbal subtests did this trend approach significance. Test involving non-verbal stimuli and coordinated motor response were impaired noticeably more than any test depending solely upon verbal input and response.

The results were discussed as they bear upon the inadequacy of some often asserted indices for the clinical diagnosis of brain damage. The implications of these findings in the context of Hebb's theories were also examined.

Microfilm \$2.50; Xerox \$5.60. 115 pages.



# ANXIETY AND DISPLACED ACTIVITY IN A LEARNING SITUATION

(L. C. Card No. Mic 60-4721)

Herbert Joseph Nickel, Ph.D.  
Clark University, 1960

Supervisor: Dr. Morton Wiener

Examination of experimentally-tested theories dealing with the relationship between (longstanding) anxiety and learning indicated considerable difficulty in accounting for the empirical relationships between anxiety and learning. Drive Theory could account for certain limited areas of functioning (primarily conditioning and the early trials of some paired-associates learning) and an Inhibition Theory showed potential promise.

In an effort to contribute toward the understanding of the relationship between anxiety and learning (performance), the present study was designed to investigate the relationship of anxiety to learning and displaced activity. The primary theoretical proposition was that high anxious (HA) people function at a lower developmental level than do low anxious (LA) people. In keeping with this notion, HA people were inferred to be more diffuse in focussing their activity than LA people; i.e., LA people integrate their activity with the demands of a task to a greater extent than do the more diffuse HA people. On the basis of these inferences, HA people were hypothesized to direct or focus activity on a task to a lesser extent than do LA people, and, conversely, to displace activity to other areas of functioning to a greater extent than do LA people. Thus, HA people should perform less well on a task and should show more displaced activity.

The task of this study was the learning of hard and easy nonsense syllable lists under massed and distributed conditions (easy massed, easy distributed, hard massed, and hard distributed tasks). The hypothesis of superior learning for the LA group was supported. The over-all learning difference between anxiety groups was due primarily to the easy massed and the hard massed tasks.

Measures of displaced activity (defined as not a part of the necessary ongoing activity of the organism and not directly related to the task on which the subject is focussing his activity) were chest muscle activity (CMA) and sitting activity (SA). The hypothesis of more displaced activity for the HA group was supported. The HA group had more SA on the easy distributed task than did the LA group, and, in addition, the HA group consistently had higher CMA and SA means than did the LA group. Also, the HA group consistently showed more displaced activity changes as a function of the task than did the LA group, suggesting that HA subjects are affected to a greater extent by task demands than are LA subjects.

A hypothesis of an inverse relationship between difficulty of a task and amount of displaced activity during that task was supported for learning conditions (massed vs. distributed conditions).

Suggestions were made for extending the conception of anxious persons presented in this study and for testing other possible interpretations of the data.

Microfilm \$2.50; Xerox \$6.60. 138 pages.

# THE ROLE OF STRESS, RIGIDITY AND INTELLIGENCE IN COGNITIVE ADAPTABILITY.

(L. C. Card No. Mic 60-5399)

Walter Nunokawa, Ph.D.  
University of Oregon, 1960

Adviser: Paul J. Hoffman

The present study was designed to investigate the effects of stress upon the ability of people differing in rigidity and intelligence to increase cognitive complexity. A rationale pertaining to the manner in which such individuals would react under stress was derived from Freudian theory. By means of a mathematical model, cognitive complexity was described in terms of a) increases in the utilization of cues, and b) increases in the relational use of cues.

On the basis of high and low scores on the Flexibility and Intellectual Efficiency scales of the California Psychological Inventory, an experimental group of 32 judges was selected from four freshmen and sophomore classes at the University of Oregon. Following familiarization with the experimental task, all judges rated 100 profiles for "sociability." These profiles consisted of scores of university students on eight Edwards Personal Preference Schedule scales selected as cues or predictors for the judgment of sociability. Subsequently, the 32 judges were independently assigned to a) a high or low flexibility group, b) a high or low intelligence group, and c) a high or low stress condition in a balanced factorial design. After an interval of a week, all judges were instructed that their accuracy could be improved by using all the information in a relational manner. High stress was assumed to exist by relating intelligence to the ability to improve accuracy; low stress, by commending the group for fine performance. The judges then re-rated the same set of profiles.

A control group was composed of 12 comparable student judges who had earlier simply rated and re-rated the profiles without the intervening instructions. The interval between administrations was about a week.

The results of the experiment indicated a significant difference between the experimental and control groups in the increased use of cues. Analysis of the experimental subgroups revealed no significant differences for main effects and no significant interactions with respect to increased use of cues. There was also no increase in the relational use of cues. Experimental subgroup variations exhibited only a few small and non-significant changes in the direction of increased complexity. The obtained results did not, therefore, support the hypotheses ventured in this study.

To account for the disconfirmed hypotheses various interpretations were considered. The preferred explanation was that little stress might have actually operated in what was assumed to be the condition of high stress. Discussion was offered for the negative findings with respect to changes in complexity and it was conjectured that, on the whole, increasing the relational use of cues might have been too difficult a task.

On the basis of the obtained results, the following conclusions were drawn:

1. The set of instructions leads to increased use of cues, but not to a greater relational use of cues.

2. Under conditions of stress, groups differing in rigidity and intelligence do not differ in judgment process complexity.

The mathematical model seems to be an adequate representation of the judgment process and remains relatively unaffected by the influence of stress, rigidity and intelligence.

Microfilm \$2.50; Xerox \$4.20. 80 pages.

# CONCEPTUAL ABILITY AND THE PERCEPTION OF INTERACTION IN MOVEMENT BY ELDERLY PERSONS

(L. C. Card No. Mic 60-5105)

Henry Beveridge Phelps, Ph.D.  
Columbia University, 1960

Chairman: Laurance F. Shaffer

It was the first purpose of this study to explore the relationship between conceptual ability and the ability to perceive interaction between moving objects. The second purpose was to extend the Babcock method, which measures intellectual deficit by comparing differences in verbal and conceptual ability, to a perceptual criterion. It was hypothesized that conceptual ability is correlated with the ability to perceive object-interaction as meaningful, and also, that conceptual ability is more highly correlated with the perception of object-interaction than is verbal ability.

Ten males and 60 females between the ages of 60 and 85 volunteered as subjects for this study. The fact that a subject volunteered for this study implied that he had confidence in his intellectual ability. This introduced a sampling error favoring the selection of brighter-than-average, more highly educated subjects who failed to show age differences in conceptual ability.

Four standard tests were employed to measure "conceptual ability": The Arithmetic and the Block Design subtests of the Wechsler-Bellevue, the conceptual half of the Shipley-Hartford, and a timed version of the Raven's Progressive Matrices. Two standard tests were used to measure "verbal ability": the Information and Vocabulary subtests of the Wechsler-Bellevue.

The perceptual criterion was measured by judges' ratings of how well each subject perceived and understood the movements of three interacting geometric figures in a film developed by Heider and Simmel. The goodness of interpretation of the film was determined by the extent to which the subject perceived the three objects as animate, goal-oriented and consistent in terms of a social context.

The results confirmed the hypothesis that conceptual ability is correlated with the perception of object-interaction, but the four conceptual tests were noted to hold varying degrees of relationship to the perceptual criterion. Block Design and Progressive Matrices were found to be the two tests most closely related to the perception of interaction while Arithmetic and the Shipley-Hartford showed a small and inconsistent relationship to the film. These findings were felt to have some pertinence to the social perception of groups limited in conceptual ability.

The Babcock-inspired hypothesis that conceptual ability is significantly more closely related to the perception of

interaction than verbal ability was not supported by this study. The reason for this was not clear. One possibility was that the brighter-than-average volunteer subjects did not have a differential loss in conceptual ability. Another possibility was that the conceptual tests did not measure their losses. The high correlations noted between education, verbal ability, and the tests of conceptual ability suggested the need for a purer measure of conceptual ability. The low relationship noted between the film scores and education, and the substantial correlation of the film with Progressive Matrices, offered some promise that such a test as the Heider and Simmel film might meet that need.

Microfilm \$2.50; Xerox \$4.20. 79 pages.

# SOCIO-CULTURAL CORRELATES OF PSYCHIATRIC DIAGNOSES

(L. C. Card No. Mic 60-5380)

Elwood Osborne Roessle, Ph.D.  
University of Houston, 1960

The purpose of this study was to investigate the interrelations between particular demographic and socio-cultural variables, and a large number of common psychiatric diagnoses, in order to determine the extent to which such variables might be related to certain diagnostic groupings, and discriminative relative to others. Seven variables were related to diagnoses; denominational status, class status, years of education, I.Q., sex, age, and marital status. Of these, the first four were treated as differential measures of the same underlying factor, namely social status. Accordingly, data pertaining to these variables were ranked in order of increasing social desirability. The sample employed in the study was composed of 1051 patients, private and staff, representing serial referrals to the Department of Psychology, University of Texas Medical Branch. Categorization of the total sample in terms of nosology provided twenty diagnostic subsamples.

In order to investigate systematically the ways in which particular diagnostic groups differed from the over-all psychiatric population on denominational status, class status, years of education, I.Q., sex, age, and marital status, and on the assumption that bias with respect to such demographic and sociocultural factors was minimal, the composition of the total sample on these variables was used as a base line relative to which differential trends were computed for each of the twenty diagnostic subsamples.

The results demonstrated that all of the diagnoses studied showed significant or discriminative relationships with one or more of the variables considered.

The following summary notes the differentiating variable or variables associated with each diagnostic category.

1. Unclassified  
schizophrenia . . . . . : Sex and I.Q.
2. Incipient  
schizophrenia . . . . . : Sex, age, religion, class, education, and I.Q.
3. Schizoid  
character . . . . . : Sex, age, religion, class, education, and I.Q.



4. Schizo-affective . . . : Sex and age.
5. Paranoid  
schizophrenia . . . : Sex and age.
6. Paranoid  
character . . . . . : Sex, age, and education.
7. Obsessive  
compulsive . . . . . : Sex, religion, class, education  
and I.Q.
8. Hysteria . . . . . : Sex, religion, class, education  
and I.Q.
9. Phobic  
character . . . . . : Sex.
10. Anxiety state . . . . . : Sex, religion, class, education,  
and I.Q.
11. Hypochondriasis . . . : Sex.
12. Depression . . . . . : Age.
13. Mixed Neurosis . . . : Sex.
14. Inadequate  
personality . . . . . : Sex.
15. Adolescent  
conflict . . . . . : Age.
16. Psychopath . . . . . : Sex and age.
17. Narcissistic  
character . . . . . : Sex, religion, class, and I.Q.
18. Mental defective . . . : Age, religion, class, education,  
and I.Q.
19. Alcoholism . . . . . : Age, religion, class, education,  
and I.Q.
20. Organic . . . . . : Sex, age, religion, class, edu-  
cation, and I.Q.

While it was concluded, on the basis of the findings, that psychiatric diagnoses are functionally related to at least one, and often several of the variables considered, no inferences were made regarding the etiological significance of such relationships. Rather, the findings were interpreted in terms of either, or both, of two broad and recurring explanatory hypotheses:

1. The sexes and members of various denominational, social, educational, and intellectual strata will express their difficulties in adjustment in ways which are characteristic of their group.
2. Diagnostic terms in psychiatry are partly a classification of patients into various social strata, with assumed differences in treatability and proper methods of treatment.

Microfilm \$2.50; Xerox \$6.60. 139 pages.

#### MULTIDIMENSIONAL ANALYSIS OF PSYCHOLOGICAL CONSTRUCTS

(L. C. Card No. Mic 60-5179)

Charles Earl Werts, Jr., Ph.D.  
University of Minnesota, 1960

Adviser: Robert D. Wirt

The purpose of this research was to investigate the discriminant and convergent validity of the four common clinical constructs: dependency, ego strength, social adjustment, and intelligence. The methodology was similar to that used by Campbell and Fiske, except that persons were ranked by experienced psychologists instead of using test scores. Four kinds of psychological data were available on each person: the Wechsler-Bellevue Intelligence Scale, the Minnesota Multiphasic Personality Inventory (MMPI), the Rorschach Ink Blots, and a vocational history. A sample of forty veterans, a majority of whom were out-patients at a mental hygiene clinic, were randomly assigned to four groups of ten each. Obvious identifying data were removed from the protocols, which were ranked in sets of ten on a given construct. No judge ranked any set of ten protocols on more than one construct, nor was any given set of ten protocols ranked by more than one judge on a given construct. The result was that each judge ranked 16 sets of protocols in a randomized Graeco-Latin Square design which was different for each judge. A four-way analysis of variance was performed on the 64 rank order correlation coefficients obtained by correlating each set of rankings with the mean ranking for the appropriate group. The mean ranking was obtained by averaging the 16 sets of rankings done on that particular group. Dependency was the only construct found to have significant cross-test validity. Test, judge, and group variance were not significant. These results suggested that when ranking people using these four tests, intelligence should only be inferred from the Wechsler-Bellevue, social adjustment from the vocational history, and ego strength from the MMPI or Rorschach. Following the argument that this type of validation is a necessary preliminary to construct validity studies, some suggestions were made for further investigation.

Microfilm \$2.50; Xerox \$3.60. 65 pages.

#### THE RELATIONSHIP OF INTERPERSONAL RESPONSES TO RATINGS AND CONTENT OF THE INTERVIEW

(L. C. Card No. Mic 60-5119)

Bernard John Wiest, D.S.W.  
Columbia University, 1960

This study investigates the problem of relationship between interview participants' interpersonal responses and interviewer judgments and quantity of interviewee content. Research in social work, psychiatry and social psychology has demonstrated interpersonal attitudes in dyadic situations affect clients' commitment to return; therapists' diagnosis, prognosis and treatment involvement; and respondents' validity in survey interviews.

Three measurements were required in this study. The

interpersonal responses, the independent measure, was obtained immediately after an interview when the interpersonal phenomena purportedly occurred. The dependent measures were rater judgments of subjects' adjustment, and the quantity of interviewee content. Given these measures, predictions were derived from the assumptions of mutual, conscious interpersonal responses and a balanced state in a purposeful, dyadic situation. The predictions were:

**General.** When the interview participants' interpersonal responses are similar, they will significantly influence rater judgments and interviewee content.

**Subsidiary.** 1. When both participants' interpersonal responses are negative, the adjustment of the subject will be rated as poor, and the interviewee content will be less.

2. When both participants' interpersonal responses are positive, the adjustment of the subject will be rated as good, and the interviewee content will be more.

**Corollary.** A & B. When the interviewer's interpersonal response is positive or negative, the adjustment of the subject will be correspondingly rated good or poor.

C & D. When the subject's interpersonal response is positive or negative, the quantity of interviewee content will be correspondingly more or less.

E. When the interpersonal responses of the interview participants are similar, ratings of subject adjustment made some time after the interview will not be significantly influenced by the interpersonal responses.

F. When the interpersonal responses of the interview participants are similar, ratings of subject adjustment made by a noninterviewer, some time after the interview will not be significantly influenced by the interpersonal responses.

Two samples ( $n=18$ ,  $n=23$ ) were drawn from a military college student population. Subjects were from the 1962 Plebe Class of the U. S. Military Academy, West Point. Each subject was interviewed by a psychiatrist and social worker. After each interview, the participants scored their interpersonal evaluations on the Interpersonal Response Scale. The interviewers rated the subjects' adjustment immediately after the interviews. Subjects' personal adjustment was rated under two other conditions remote from the interviews to test the differential influence of interpersonal responses. Quantity of interviewer content was measured using the interviewee utterances from a random page of transcript.

Generally, the subsidiary and general hypotheses were supported, although relationships did not attain a significant level of probability. The corollary hypotheses, A, B, C and D, were supported in both psychiatrist and social worker interviews, the former attaining the .01 level of confidence. The corollary predictions, E and F, were not supported, conditions of adjustment ratings remote from the interview being related to interpersonal responses at the same level as the condition proximal to it.

Conclusions are that when an interviewee feels positively about the interview transaction, he is more likely to produce more content; when he feels negatively about it, he is more likely to say less. When the interviewer evaluates the interpersonal experience as negative, he is more likely to rate subject adjustment as poor, and when he feels positively about the interchange, he is more likely to rate adjustment as good. The greater effect of mutual interpersonal responses of both participants was not demonstrated. The findings do not contradict this eventuality

under clinical conditions of greater personal investment by both participants. The results are consistent with research cited regarding the saliency of interpersonal evaluations in a purposeful dyadic situation; with the conceptual model of a balanced interpersonal state; and supports the notion of the model's application to a social casework setting. Microfilm \$2.50; Xerox \$6.20. 129 pages.

## PSYCHOLOGY, EXPERIMENTAL

### AN EVALUATION OF CAMERON'S CONSTRUCT OF PARANOID PERCEPTUAL REORGANIZATION USING A SYNDROME-CLUSTER ANALYSIS

(L. C. Card No. Mic 60-5414)

Stephen E. Beltz, Ph.D.

The Pennsylvania State University, 1960

The specific problem of the present study was to test the description of the delusional person's preferred ways of reacting, in terms of the modes derived from Cameron's theory of paranoid development. Cameron has described the process of perceptual reorganization as the ability to alter perspectives, to change attitudes, and to shift from one attitude to another. He particularly relates this major construct to his theory of paranoid development. The general problem of the present study was to reduce the construct of perceptual reorganization, as proposed by Cameron, into the syndrome-cluster, syndromes, modes and adaptive properties suggested by Klein and Schlesinger. The syndrome-cluster, thus derived, was composed of four major syndromes: 1.) shifting; 2.) overexclusion; 3.) reaction-sensitivity; and 4.) complexity. There were eight hypotheses, taken directly from the analysis of modes or preferred behavior. The shifting hypotheses predicted, for the delusional person, fewer spontaneous shifts, a fewer number of alternate responses, a longer time required to make a shift to another arrangement and a longer time to complete the alternate response. The overexclusion hypothesis predicted, for the delusional person, more stimulus elements excluded from arrangements. The reaction sensitivity hypothesis predicted, for the delusional person, a shorter reaction time on the initial arrangement and a shorter response time on the initial arrangement. The complexity hypothesis predicted, for the delusional person, a fewer number of multidimensional responses.

One experimental situation was selected, from the several suggested by Cameron, consisting of five sets of stimulus elements which the subject was given, together with an instructional set to "arrange" and to "rearrange" them.

The subjects, used in the present study, consisted of nineteen delusional psychotic females as the experimental group; nineteen female psychiatric aides as the normal control group; and an additional fourteen non-delusional psychotic females as a second control group. The presence or absence of an active delusional process served as the individual difference variable. The patients were assigned to the groups on the basis of judgments agreed upon by five out of six judges. These judgments were based on



information selected from the case history; a list of behavioral symptoms, obtained by direct interviews with ward personnel; and a complete description of delusional ideation present, obtained from ward personnel. The subjects were matched on twelve control variables. Each subject was seen individually and tested for intelligence, attention span, and color blindness before the experimental tests were administered.

The analyses of variance were significant on six of the eight measures. When the *t*-ratios of the difference between the means were ranked, the smallest *t*-ratios were those between the two patient groups on all of the measures except one. It was tentatively concluded that the delusional modes were not demonstrated by the present study and that the significance of the *F* tests probably could be attributed to a schizophrenic syndrome-cluster of perceptual reorganization. These modes were then empirically derived from the data. Suggestions for further research were offered. Microfilm \$2.50; Xerox \$5.40. 110 pages.

**AN EXPERIMENTAL STUDY OF  
THE EFFECTIVENESS OF CLIENT-CENTERED  
THERAPY IN COUNSELING STUDENTS  
WITH BEHAVIOR PROBLEMS**

(L. C. Card No. Mic 60-5515)

Angelo Victor Boy, Ed.D.  
Boston University School of Education, 1960

**Problem:** To measure the effectiveness of client-centered therapy in counseling students classified as behavior problems at the Parlin Junior High School, Everett, Massachusetts.

**Scope:** The study, carried on for a twelve school-week period, included thirty-six students classified as behavior problems by both teachers and administrators. These students, who were undergoing daily after-school detention, were divided into three numerically equal groups and were matched on seven variables.

The Experimental Group (A) was released from after-school detention and was the group with whom 143 client-centered counseling sessions were carried on by two school counselors who were classified as client-centered therapists by two separate juries. The Traditional Control Group (B) continued with after school detention and received no counseling assistance. The Laissez Faire Control Group (C) was released from after-school detention and received no counseling assistance.

**Procedures:** In comparing the three groups against each other on sixteen variables before the start of the study, it was found that there were no appreciable differences among the three groups.

The following procedures were undertaken with the three groups both before the start of the study and at its conclusion in order to determine significant differences between pre and post-counseling investigations: (1) comparisons of mean correlations between the actual-self and ideal-self by means of the Q-sort technique, (2) comparisons of teachers' behavior ratings of students by use of a behavior rating scale, (3) comparisons of mean

proportions of peer groups accepting students in study by utilization of a sociogram, (4) comparisons of mean proportions of peer groups rejecting students in study by utilization of a sociogram, and (5) comparisons of definiteness of educational and/or vocational objectives.

**Results:**

In the pre and post-counseling comparisons, the following results were evident:

1. The Experimental Group (A) achieved a significantly higher mean correlation between the actual-self and ideal-self. Neither of the control groups achieved any significant gains in this area.
2. The Experimental Group (A) achieved significantly improved teachers' behavior ratings. Neither of the control groups achieved any significant gains in this area.
3. Neither the Experimental Group (A) nor the control groups were significantly more accepted by peer group members.
4. The Experimental Group (A) was significantly less rejected by peer group members. Neither of the control groups achieved any significant gains in this area.
5. The Experimental Group (A) achieved a marked improvement in the definiteness of educational and/or vocational objectives. Neither of the control groups achieved any significant gains in this area.

**Conclusions:**

The primary conclusion in this study is that client-centered therapy is effective in counseling students classified as behavior problems. Specifically, the Experimental Group (A), as a result of its experience with client-centered therapy:

1. Achieved a significantly higher congruence between the actual-self and ideal-self.
2. Achieved significantly improved teachers' behavior ratings.
3. Was not significantly more accepted by peer groups.
4. Was significantly less rejected by peer groups.
5. Showed a marked improvement in the definiteness of educational and/or vocational objectives.

The Traditional Control Group (B) and the Laissez Faire Control Group (C) were relatively static and made no significant gains toward the study's objectives. This indicates that the control situations in which these groups functioned were not conducive to the attainment of the study's objectives.

**Suggestions for further study:** That a similar study be conducted . . .

1. Using a different classification of students.
2. At institutions of differing size, type, and locale.
3. In a situation in which students with behavior problems are earlier identifiable, thus allowing a sufficient time lapse for a full scale follow-up.

4. Using a different approach to counseling.
  5. Using more and different control groups.
  6. With either different or no time limits placed on the number of counseling sessions.
- Microfilm \$2.50; Xerox \$9.70. 211 pages.

**TEMPO AND EXPRESSIVE PROPERTIES OF  
AUDITORY FIGURES:  
A PSYCHOPHYSICAL STUDY.**

(L. C. Card No. Mic 60-6499)

Henry Russell Cort Jr., Ph.D.  
Cornell University, 1960

The hypothesis that tempo affects the expressive properties of auditory figures was tested. Subjects described two pure-tone melodies that varied in tempo and musical mode by rating them in terms of eight categories of emotional expression. Presentation order was varied. Results supported the hypothesis. Other findings were that presentation order and practice interacted; musical mode did not affect subjects' responses significantly; and the method used yielded very internally consistent results. The relation of results to a factor theory of perceptual characteristics was discussed.

Microfilm \$2.50; Xerox \$5.40. 109 pages.

**THE GALVANIC SKIN RESPONSE  
AS A FUNCTION OF CLASSICAL  
CONDITIONING, "INSTRUCTIONAL"  
CONDITIONING, AND CLINICAL ANXIETY.**

(L. C. Card No. Mic 60-5158)

Donald Gene Davenport, Ph.D.  
University of Minnesota, 1960

The present study was an attempt to utilize recent methodological refinements in GSR conditioning to determine more adequately the relative effectiveness of classical and instructional conditioning as alternative procedures for associating a GSR with a previously neutral stimulus. An additional purpose was to study the possible interaction of both classical and instructional conditioning with the experimental variable anxiety.

A sample of 40 male patients admitted to the Psychiatric Service of the Minneapolis VAH were classified into high and low anxiety groups. Five clinical psychologists estimated the anxiety of the patients from admission psychometrics, which included the MMPI, Shipley-Hartford Retreat Scale, and a biographical data sheet.

Each patient received a classical conditioning and an instructional conditioning procedure with the order counterbalanced over Ss. Classical conditioning consisted of eight paired presentations of a one-half second white noise CS followed by a brief, 5.4 milliamper, D.C. electric shock US. Instructional conditioning consisted of verbal instructions which informed the patients that electric shock would follow the white noise. These instructions replaced

the actual pairing of the stimuli for this aspect of the experimental session. The effectiveness of the two conditioning procedures and their relationship to anxiety level were determined on the basis of GSR magnitudes in log conductance units from the eight extinction "test" trials which followed each procedure.

The results were as follows: (a) Both conditioning procedures significantly increased the magnitude of the "conditioned" GSR. (b) There was no evidence that one of the procedures was superior to the other either in terms of GSR increase or resistance to extinction. (c) There was slight evidence that both conditioning procedures produced less of an increase in GSR magnitude when studied second. This appeared to be largely the consequence of incomplete extinction following the first conditioning procedures used, and did not represent an adaptation or fatigue effect due to the length of the experimental session. (d) Anxiety ratings by clinical psychologists based on psychometrics were closely related to those obtained in an objective manner from ranks on the Taylor Manifest Anxiety Scale, the Welsh Anxiety Index, and the Welsh Factor A Scale. (e) There was no evidence for the influence of anxiety level on the two conditioning procedures, either in terms of an increase in GSR magnitude during conditioning or resistance to extinction during the test trials. An apparent greater responsiveness by the high anxiety group on the first extinction trial was not statistically significant. (f) The absolute magnitude of the mean unconditioned GSRs to shock were greater for the high anxiety groups than the low anxiety groups, but this difference also did not reach statistical significance. (g) Attempts to "purify" the anxiety criterion did not change the interpretation of the effects of anxiety on conditioning.

The suggestion was made that in GSR studies, the term "conditioned response" should be used to designate those responses occurring at approximately the time the US normally was presented during the classical conditioning procedure regardless of the CS-US interval. Thus, this term would not be used for the responses established by any of several methods which occur with a latency equivalent to that of the GSR reflex to the CS. This would eliminate the need for preliminary adaptation trials, possibly reduce the sensitivity of the CR to instructions, and re-establish the classical conditioning operation as the primary controlling factor of the magnitude of the CR.

Microfilm \$2.50; Xerox \$4.80. 91 pages.

**PRELIMINARY INVESTIGATIONS IN  
THE EFFECT OF CONTINUALLY CHANGING  
REINFORCEMENT ON  
LEARNING AND EXTINCTION**

(L. C. Card No. Mic 60-4669)

Michael Dinoff, Ph.D.  
The University of Tennessee, 1960

Major Professor: G. R. Pascal

Three groups of experimentally naive pigeons at 80 plus or minus 3 per cent of their twenty-four hour deprived body weight were conditioned to different degrees of variation in the reinforcing stimulus of food (i. e., one, two, or



three changes). All *Ss* were trained in the standard Skinner box to peck a window for food reinforcement of controlled nutritional value but of different colors. Subjects were reinforced on a three minute aperiodic schedule. After a criterion of conditioning was met, *Ss* were extinguished to a pre-arranged criterion. Upon completion of extinction, a second conditioning round was begun with each *S* appearing in a different experimental condition. After a second extinction, *Ss* were conditioned in the presence of the third degree of reinforcement variation and again extinguished. Three possible trends were suggested for the data.

The most consistent finding is that the more reinforcement variation, the higher the resulting level of responding. Three reinforcement changes lead to a higher response level than two changes which, in turn, produced more reacting than no change. Differences occurring in extinction partly reflect the conditioning effects. None of the findings were highly significant.

The results seem most consistent with the "bits" or amount of reinforcement and the novel stimulation hypotheses. A Hullian or a cue-change prediction could not account for the findings.

An experiment involving reinforcement variation on human *Ss* using the Hunter-Pascal Concept Formation Test was also reported. The results of this experiment are inconsistent with the other research reported here in that the more variation in reinforcement, the more performance was impaired.

Suggestions for further research have been indicated. Possible theoretical implications were also suggested.

Microfilm \$2.50; Xerox \$4.80. 95 pages.

#### EFFECTS OF VARYING THE RATE OF RESPONSE AND OF SCHEDULE DISCRIMINATION TRAINING ON STIMULUS GENERALIZATION GRADIENTS

(L. C. Card No. Mic 60-5228)

Herbert Friedman, Ph.D.  
The University of Connecticut, 1960

##### Part I

These experiments are designed to determine if the previously reported effect of increased motivation flattening stimulus generalization gradients is a function of the increased drive directly or of the resulting increase in response strength (measured by rate).

**Experiment 1** - 14 Carneau pigeons, divided into 3 groups and maintained at 70%, 80% and 90% of ad lib. weight, were trained to peck to a 550 mu stimulus with VI 1 reinforcement. Over the course of 3 weeks three stimulus generalization tests were given each bird during extinction. Before each test either dexedrine, pentobarbital or water was administered. After transforming the data to log ( $N - 1$ ) the gradients were found to be essentially linear. Dexedrine reduced the rate of response but had no effect upon the slope of the generalization gradient. Pentobarbital had no effect on rate but did flatten the slope. No relationship between rate of response and slope of the gradients was found, nor differences among drive levels.

**Test A** - Since the testing in Experiment 1 was during extinction, the effects of the drugs could be partially

explained if the drugs affect the course of extinction. To test this the birds used in Experiment 1 were given a 30 minute extinction session after the third generalization test. The hypothesis was not supported since no appreciable differences in number of responses between the drug groups and the water control were found.

**Test B** - To test if the effect of the drugs upon rate is different during training than extinction, the same 14 birds were used. Half were given dexedrine and half pentobarbital. Half of each drug group was given a training session at VI 1 and half an extinction session. Dexedrine was found to increase rate during training and decrease it during extinction. Pentobarbital was found to increase rate during extinction but had little effect during training.

**Experiment II** - If gradients are obtained during training rather than extinction, drug effects on rate would provide additional evidence on the rate-slope relationship. The same 14 birds were used and Experiment 1 was repeated except testing was during training. Dexedrine now increased the rate slightly but still had no effect on slope. Pentobarbital again increased rate and flattened slope. No differences among drive levels were found nor any relationship between rate of response and generalization slope.

It is concluded that rate is not a factor in generalization slope. There was no evidence that drive level is involved in slope. It appeared that the effect of dexedrine upon rate is determined by whether a training or an extinction situation is used.

##### Part II

To study the effects of schedule discrimination training on stimulus generalization gradients produced in a training situation, 7 naive Roller pigeons were given variable interval reinforcement for pecking at 2 wavelengths of light presented alternately. A VI 1 schedule was used in the presence of 550 mu and VI 5 for 570 mu. A generalization test in a training situation produced a gradient very similar to that obtained by Guttman (1959) after the same training but testing during extinction. It also looked like the gradient obtained during extinction by Hanson (1959) after training at 550 mu at VI 1 and extinguishing at 570 mu. It is concluded that Guttman's assumption that his results were restricted to the extinction situation is unfounded and the relative properties of schedules in discrimination training may be at least as important as the absolute properties.

Microfilm \$2.50; Xerox \$5.00. 96 pages.

#### AN EXPLORATORY STUDY OF A PROJECTIVE-OBJECTIVE PERSONALITY TESTING TECHNIQUE

(L. C. Card No. Mic 60-6113)

Elizabeth Kinzie Ignatowski, Ph.D.  
Purdue University, 1960

Major Professor: Lawrence M. Baker

The primary purpose of this study was to investigate the effectiveness of a personality testing technique which attempted to combine projective and objective personality test approaches. To pursue this aim, the Experimental

Test Battery was constructed which consisted of three subtests: Picture subtest, Inkblot subtest, and Controlled Word Association subtest (CWA). The effectiveness of the technique was judged on the basis of how well the subtests differentiated emotionally healthy (control) and disturbed (experimental) subjects.

The Picture subtest consisted of 56 sentences which were taken from the objective group form of the Michigan Picture Test (MPT), and 60 stories which described the six pictures. The story items were derived from the stories which were told by a group of subjects in a pilot study where the six pictures were presented using standard TAT administration procedures (Stein, 1948).

The Inkblot subtests was composed of 188 percepts which described one black-and-white and three colored inkblots. The percept items were written from responses given to the inkblots in the aforementioned pilot study where standard Rorschach test administration procedures (Klopfer, 1954) were used.

All items on the Picture and Inkblot subtests presented the testee with the forced-choice method of response: "Agree-Disagree."

The CWA subtest was a list of 28 items derived from Maller's (1936) Controlled Association Test. Each item contained a stem word followed by two associative responses, one of which the testee selected.

The Experimental Test Battery was administered to 32 matched pairs of subjects all of whom fell in the 9-14 year age range and lived in, or near, Gary, Indiana. Each pair contained a control subject and an experimental subject who were matched on age, plus or minus six months; sex; and race. An attempt was made to match on intelligence, occupational level of father, number of siblings, and religious affiliation.

Because of the exploratory nature of the study, the level for significance was set at .15, or smaller. An item analysis was conducted by means of a significance test of the difference between correlated response frequencies for each test item.

The item analysis revealed that the CWA subtest elicited the greatest percentage of differential responses from the control and experimental subjects. Approximately one third of the items were significant. However, when the CWA responses of the subjects were scored according to a system recommended by Maller (1936), the subsequent t-test on group mean scores did not reveal a significant difference in the responses of the control and experimental subjects. Explanations were offered to account for the lack of confirmation of this particular set of norms.

The Picture subtest ranked second in discriminatory power; slightly more than one quarter of the items elicited differential responses. The story was a more effective type of item than the MPT sentence.

The inkblot comprised the least effective subtest, with less than one fifth of the percepts emerging as significant discriminators.

The content of the discriminatory and less discriminatory stimuli and items within subtests was qualitatively analysed. It was tentatively concluded that the "best" pictures and inkblots were ambiguous in form, the "best" test items were disguised in the impulses and feelings described, and the "best" pictures were those which were selected to tap adjustment to societal and maternal authority. Less effective were pictures dealing with peer and sibling relationships.

The conclusions drawn from the present study were necessarily limited in scope because of the small samples of subjects, and the sometimes imperfect matching of control and experimental subjects (especially in intelligence, reading skills, and school achievement). Also, at least one subtest (Inkblot) did not discriminate much beyond the chance level. Nonetheless, the relative effectiveness of the CWA and Picture subtests in discriminating control and experimental subjects, tends to lend support to other research studies which have sought to demonstrate the feasibility of developing projective-objective testing techniques for the assessment of adjustment in children.

Microfilm \$2.50; Xerox \$5.40. 109 pages.

#### AN EXPERIMENTAL INVESTIGATION OF SOME BEHAVIORAL CONCOMITANTS OF PHENYLKETONURIA

(L. C. Card No. Mic 60-4550)

F. J. King, Ph.D.

The University of Texas, 1960

Supervisor: Jackson B. Reid

The present study was undertaken in order to observe the behavioral and biochemical effects of administration of selected amino acids to phenylketonuric subjects and to investigate the relationships of amino acid excretions to behavioral concomitants of phenylketonuria. The three experimental subjects (two females, one male) were siblings; the fourth subject (male), used as a control, was unrelated to the others.

Experimental treatments were in the form of amino acids given in addition to the regular diet. Subjects I and II each received twenty-one grams of 1-asparagine daily, while subject III was given ten grams of 1-glutamine. Subject IV received six grams of lactose as a placebo.

Behavioral variables were measured through use of standardized tests, learning tests, and behavior ratings. Biochemical variables were measured by paper chromatography of urine specimens. Pre- and during-treatment comparisons were made of the phenylpyruvic acid/phenylalanine ratio as well as of psychological test scores. The behavior ratings for each subject were intercorrelated and factor analyzed; loadings of biochemical variables on behavioral factors were estimated.

The glutamine fed subject showed significant increases in both I. Q. and social age and a significant decrease in the phenylpyruvic acid/phenylalanine ratio. One asparagine fed subject showed a significant increase in I. Q. and a corresponding decrease in the phenylpyruvic acid/phenylalanine ratio. Findings for the other two subjects were essentially negative.

Examination of the factor matrices revealed that certain behavior patterns were consistently related to phenylpyruvic acid excretion. As phenylpyruvic acid excretion increased, there was a drop in a subject's ability to be stimulated by his external environment.

Microfilm \$2.50; Xerox \$5.20. 105 pages.



# EFFECTS OF SINGLE TASK LEARNING AND MULTIPLE TASK LEARNING ON SUBSEQUENT LEARNING

(L. C. Card No. Mic 60-5673)

Samuel David Leonard, Ph.D.  
State University of Iowa, 1960

Chairman: Professor Don Lewis

Two experiments were conducted to study the relative effects of single task and multiple task learning on later learning and relearning. These experiments were suggested by conflicting results obtained from a recent paired associate perceptual-motor study in the Iowa laboratory and earlier studies reported by Underwood (1945).

The Star Discrimeter provided paired associate perceptual-motor learning tasks. The correct responses were movements of the response lever into the appropriate one of six channels. Different tasks were obtained by varying the stimulus response connections.

In Experiment 1 four groups of fifteen subjects practiced under the experimental conditions and one group of thirty subjects practiced under control conditions. The experimental groups were divided into single task and multiple task pretraining conditions. Multiple task groups practiced on a new task every four trials while single task groups practiced on the same task throughout the pretraining period. One-half of the subjects in each condition practiced for 12 trials and the others practiced for 24 trials.

A significant interaction between the effects of amounts and types of pretraining was found in the correct response scores on the transfer task. Analyses made within conditions of pretraining revealed no dependable differences. However, analyses made within amounts of pretraining indicated that multiple task pretraining produced more positive transfer effects than single task pretraining when 24 trials of pretraining were given.

The error data for the transfer task showed interference from the pretraining occurring early in learning of the transfer task, but facilitation occurred as the learning progressed. The single task groups were superior to the multiple task groups in over-all performance, as measured by error scores on this task.

Experiment 2 was conducted to ascertain the relative effects of three different amounts of OL on performance during RL following single and multiple task IL. Differences between single and multiple task IL groups were not independent of the amount of OL practice received by those groups.

In general, the multiple task IL groups performed in a superior fashion in relearning when larger amounts of pretraining were given. This superiority was not found in the groups to whom the smallest amount of OL was given.

The results of Experiment 2 were attributed to relatively greater differences in degree or differentiation of the OL task from the IL task between the shorter OL period groups than between the longer OL period groups.

Microfilm \$2.50; Xerox \$4.00. 73 pages.

# DISCRIMINATION OF SOME DIMENSIONS OF CONNOTATIVE MEANING

(L. C. Card No. Mic 60-5241)

Alan Jay Lieberman, Ph.D.  
The University of Connecticut, 1960

An experiment was conducted to determine if subjects could learn to discriminate between two groups of words, differing principally in connotative meaning, if they are reinforced to do so but not informed about the difference in connotation. Six experimental word lists were compiled, each composed of two thirty word sublists. Ninety college undergraduates acted as subjects and were assigned at random to work individually with one of these lists. The sixty experimental words were printed individually on cards and handed, one at a time and in random order, to S. S was instructed to place the word card in one or the other of a pair of tandem card racks. Reinforcement consisted of S being informed of the correctness of his placement. E had predetermined, on the basis of connotation, that each sublist would belong in one of the racks and this determined correctness of response. S was forced to correct his incorrect placements by shifting a word card to the other rack. Thus the two card racks always contained either originally correct or corrected responses.

Connotative meaning was measured by sublist mean Osgood Semantic Differential (OSD) scale ratings. OSD scales used were: Good-Bad, Active-Passive and Angular-Rounded. Sublists within the same experimental list primarily connoted one or the other Polar Adjective (eg. "Good" or "Bad") which define the limits of these scales. Sublists differed substantially along only one OSD scale. Experimental lists differed in the intensity, also measured by OSD scale ratings, with which their constituent sublists connoted meaning. The two levels of intensity used, High and Low, implied, respectively, strong connotation of a Polar Adjective (eg. strongly "Good" words) or weak connotation.

Controls were instituted to prevent sublists in the same experimental list from differing along dimensions other than the selected connotative meaning. Control was attempted for: initial letter, number of letters, number of syllables, part of speech and word familiarity. Good control was achieved in all except differences in word familiarity.

The data of the learning experiment indicated that discrimination between lists of words, which primarily differ in connotative meaning, can occur. The measure of learning was number of correct word card placements. As anticipated, discrimination was better with sublists which differed strongly in connotation than those with mild difference. An unexpected finding was the ordering of terminal levels of learning according to kind of connotative meaning. The order was: Good-Bad, Active-Passive and Angular-Rounded.

The experimental findings were explained by means of an S-R paradigm of selective learning. It was contended that S learned to discriminate because similarity in connotative meaning led to generalization of the discriminative response among words of the same sublist. This generalization, the theoretical analysis stated, was mediated by the common cue producing or feedback properties of sublist words. Principal emphasis was placed on the feedback associated with sublist connotative meaning and a measure of the amount of such feedback was devised. When this measure was compared with terminal learning levels, a

substantial correlation resulted. However, a measure of sublist difference in word familiarity was also found highly correlated with final level of learning, indicating a partial confounding of the influence of this variable with connotative feedback in predicting amount of discrimination learning.

With reference to the Osgood Semantic Differential, the data of this study suggest that amount of connotative feedback may underly those ratings as well as the discrimination learning observed in this experiment. Specifically, ratings of difference in kind and intensity of connotative meaning may, as amount of discrimination may also, be a function of amount of mediational feedback.

Microfilm \$2.50; Xerox \$6.00. 124 pages.

#### THE EFFECTS OF CHLORPROMAZINE AND D-AMPHETAMINE ON EYELID CONDITIONING

(L. C. Card No. Mic 60-5678)

Harold Wayne Ludvigson, Ph.D.  
State University of Iowa, 1960

Co-Chairmen: Professor Kenneth W. Spence  
Professor John R. Knott

This experiment was designed to study the effects of chlorpromazine, a tranquilizing drug, and d-amphetamine, a central stimulant, on the acquisition of the conditioned eyelid response in humans.

The chlorpromazine was administered in 25-mg. tablets and the d-amphetamine in 5-mg tablets. Placebo tablets given to a third group were identical in appearance to the chlorpromazine. All Ss took one tablet five hours and another one hour prior to 80 conditioning trials. Subjects were males between the ages of 21 and 36 years. Twenty-three Ss were assigned to the d-amphetamine group and 20 Ss each to the chlorpromazine and placebo groups.

The group that received chlorpromazine gave consistently more CRs over all blocks of ten trials than did the placebo group, and more CRs over the last six blocks of trials than did the d-amphetamine group, although the differences were not statistically significant. In the chlorpromazine and d-amphetamine groups, Ss who reported some subjective effects of the drugs generally performed at a higher level than Ss who reported no effects of these drugs. Similarly they gave more CRs than did Ss in the placebo group. These differences also failed to reach statistical significance, however.

Implications of the results for a theory of emotionally based drive were discussed.

Microfilm \$2.50; Xerox \$3.60. 65 pages.

#### RESPONSE DURATION IN REGULAR REINFORCEMENT, EXTINCTION, AND DISCRIMINATION TRAINING.

(L. C. Card No. Mic 60-5834)

Stuart Margulies, Ph.D.  
Columbia University, 1960

The first part of this study was devoted to response rate and response duration in operant level, regular reinforcement, extinction and several spontaneous recovery sessions. After three 40 minute operant level sessions, the 30 subjects, divided into 5 groups of 6, were given 25, 50, 100, 250 or 1,000 reinforcements followed by five 40 minute extinction sessions. Mean response duration increased during the first 40 minute operant level session, high values being generally observed during this session. Mean response duration decreased during conditioning with regular reinforcement, approaching an asymptote after approximately 100 reinforcements. The range of response durations decreased during conditioning, long response durations occurring with smaller frequency.

Mean response duration during the first few minutes of extinction was small, similar to the values observed late in conditioning, but increased gradually during the 40 minute extinction session. Low values were again evidenced early in the second extinction session, once more increasing to high values during this session. Mean response duration was higher in the second extinction session than in the first. The later extinction sessions did not differ from operant level sessions in mean response duration observed.

An analysis of different reinforcement groups suggests that the percentage of short duration responses (responses less than .267 seconds) in the conditioning distribution increases as a function of reinforcements. A consideration of conditioning-extinction relations suggests the percentage of short duration responses in extinction should also be a function of number of reinforcements, a result which the present study appears to confirm.

In support of previous findings, mean number of responses made in extinction increases as a function of number of reinforcements, the number of responses made in successive spontaneous recovery sessions declines, and the number of responses made in operant level declines after the first session.

The second part of this study was devoted to a consideration of response rate and response duration in discrimination training. Thirty rats, divided into five groups of six, were exposed to 15 repetitions of a cycle in which regular reinforcement was given for 45 seconds in the presence of light ( $S^D$ ); during alternating periods of darkness ( $S^\Delta$ ), no reinforcement could be obtained. In four groups (termed "fixed length  $S^\Delta$  groups"),  $S^\Delta$  was constant from cycle to cycle, taking values of 3, 12, 45, or 120 seconds for these groups, respectively. In the fifth group ("variable length  $S^\Delta$  group"),  $S^\Delta$  length varied from cycle to cycle with an arithmetic mean of 45 seconds.

Response rate in  $S^D$  was generally higher than response rate in  $S^\Delta$  and was independent of  $S^\Delta$  length, but response rate in  $S^\Delta$  decreased as a function of  $S^\Delta$  length. Similarly, mean response duration in  $S^D$  was shorter than mean response duration in  $S^\Delta$  and was independent of  $S^\Delta$  length, but mean response duration in  $S^\Delta$  increased as a function of  $S^\Delta$  length. A higher mean response rate is found in the



last third of  $S^\Delta$  than in the first third for animals of the fixed length  $S^\Delta$  groups, but mean response duration appears to be constant from the beginning to the end of  $S^\Delta$ . Response rate appears to decline from the first third of  $S^\Delta$  to the last third in the variable length  $S^\Delta$  group, while response duration appears to increase from the beginning to the end of  $S^\Delta$  for this group.

Microfilm \$2.50; Xerox \$6.60. 137 pages.

**A MICROGENETIC STUDY  
ON THE INTEGRATION  
OF ELEMENTS INTO A UNIFIED WHOLE**

(L. C. Card No. Mic 60-4720)

Joseph Henry McFarland, Jr., Ph.D.  
Clark University, 1960

Supervisor: Heinz Werner

The problem investigated is the integration of elements into a unified behavioral whole. By means of a microgenetic method, the sides of a triangular visual pattern, ab, bc, and ca, are successively presented. Subjects draw what they see after each presentation of the sides. In this way, the means by which subjects integrate these elements into a perceptual whole are studied, i.e., the means by which ab and bc are seen as having b in common.

The process of integration may be analyzed into two aspects: 1) establishment of topical relationships and 2) establishment of figural relationships. Increasing stability in localizing the elements of the visual pattern (establishing stable topical relationships) progresses from spatial juxtaposition of the elements, i.e., ab and bc are not seen as having b in common, to continuity of the elements, i.e., ab and bc are seen as having b in common. It is this progression that permits figural relationships to change from a relation of the sides in terms of similarity in direction, i.e., ab and bc are seen as similar in orientation, to a relation of the angular relations of the sides in terms of similarity in angular size, i.e., angle of ab and bc is seen as similar in size to angle of bc and ca.

Conditions which affect both of these relationships are studied:

**Topical relationships.** The effect of absolute (egocentric) localization of the pattern's sides, in conjunction with eye movements which delineate the sides, accelerates the build-up of stable localization of the sides. Relative localization of a constant light, a constant tone, and temporal patterns of clicks also accelerate the build-up of stable localization of the sides and decrease the use of similarity to relate sides in terms of direction and angles between the sides in terms of angular size. One interesting feature of these results is that relative localization of auditory stimuli prevents complete stability, i.e., ab and bc are seldom seen as having b in common but rather, they are seen as having their b ends in spatial proximity.

**Figural relationships.** Relative localization of a constant high or low pitch tone also affects the figural relations between the pattern's sides in that the use of similarity to relate angles between the sides in terms of angular size continues despite an increase in stability of localization of

these sides. Further, depending on the tone, different angles of the pattern are related as similar in size.

Microfilm \$2.50; Xerox \$4.60. 86 pages.

**A STUDY OF LOUDNESS CHANGES  
ASSOCIATED WITH THE  
ACOUSTIC REFLEX WHEN  
PITCH LEVELS ARE EQUATED**

(L. C. Card No. Mic 60-5693)

William Frederick Prather, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor Arnold M. Small, Jr.

An investigation was undertaken to measure the loudness change in pure tones as a result of noise stimulation in the opposite ear. It was implicitly assumed that the noise resulted in a binaural acoustic reflex and that this mechanism was responsible for observed loudness and pitch changes. The primary purpose of the study was to compare intra-subject and inter-subject variabilities of these loudness change values over five replications obtained for ten subjects under two conditions: (a) the subjects were required to match for loudness without regard to any pitch changes and (b) they were required to match for both pitch and loudness.

All subjects had essentially normal hearing bilaterally and were given preliminary training sessions in matching for pitch and loudness. The following experimental parameters were used:

- (a) Tone Level: 20 db and 80 db sensation level.
- (b) Noise Level: 40 db and 100 db sensation level.
- (c) Frequency: 250, 500, 1000, 2000, and 3000 cps.

Each of the 20 combinations of the three parameters above were presented under the following two conditions:

- (a) Loudness match alone.
- (b) Pitch and loudness match.

Subjects were required to match for loudness or pitch and loudness, depending upon the condition, a variable tone presented in one ear to a standard tone presented in the same ear immediately following the variable tone. A noise was introduced concomitantly into the opposite ear during the presentation of the standard tone.

Two analyses of variance, one for each condition, were carried out using the four dimensions of tone level, noise level, frequency, and subjects. Tone level and noise level, but not frequency, were significantly contributing factors to the total variance of the loudness change values under both conditions. Graphic representation of the loudness changes as a function of the three experimental parameters indicated that a reduction in loudness of the standard tone occurred for the 100 db noise levels, except for the 20 db tone level in the loudness and pitch match condition. Negative values (facilitation of loudness of the standard tone) occurred for the 40 db noise levels and were more marked for the 20 db tone levels.

Forty treatments by subjects designs were carried out to compare intra-subject variabilities between each condition and between certain combinations of parameters within each condition. The results of these analyses showed that subjects are variable within themselves to about the

same degree in the loudness balance alone condition as in the loudness and pitch match condition. Where there was a significant difference in within-subjects variability between the two conditions, it was in the direction of more variability in the loudness and pitch match condition than in the loudness balance alone condition. Subjects were also more variable within themselves for the 20 db tone levels than for the 80 db tone levels and for the 100 db noise levels than for the 40 db noise levels.

Intraclass correlation coefficients were also computed for each of the 20 combinations of parameters in each of the two conditions. No clear trend as a function of the experimental variable was apparent.

An analysis of variance, using data collected for frequency change between the standard and variable tones in the loudness and pitch match condition, was carried out. None of the four variables of tone level, noise level, frequency, or subjects was significant.

The results are discussed with respect to similar studies reported in the literature. One of the more important findings appeared to be that of a facilitation effect noted for the 40 db noise levels and for the 20 db tone levels. Possible explanations are discussed for this facilitation effect.

Microfilm \$2.50; Xerox \$4.40. 83 pages.

#### THE EFFECT OF TYPE OF VERBAL PRETRAINING ON TRANSPOSITION IN CHILDREN

(L. C. Card No. Mic 60-5694)

Louis Elliot Price, Ph.D.  
State University of Iowa, 1960

Chairman: Professor Charles C. Spiker

There are experiments reported in the literature that suggest that when children can use effectively the appropriate verbal concept in a transposition study, they will transpose more than children who cannot effectively use the appropriate verbal concept. These children will transpose on both a near and a far test and in both a two-stimulus and three-stimulus problem. None of these studies has manipulated experimentally the verbal response. The present experiments have experimentally manipulated the type of verbal name used by *S*, in a three-stimulus problem with the stimuli differing on the weight dimension.

The hypothesis tested in these experiments is that children given pretraining with a meaningful relational name would perform better on a transposition test than children pretrained with an absolute nonsense name or children given no pretraining. In the first experiment 72 kindergarten and first grade children were divided into three groups, Group R (relational), Group A (absolute), and Group N (no pretraining). Groups R and A were pretrained with the names "middle-heavy" and "dag-heavy," respectively, for the middle weight of three stimuli. Then all *Ss* were given a discrimination learning task in which three levers differing in weight were the stimuli. The task of all *Ss* was to learn to choose the middle-weight lever consistently. One-half of the *Ss* in each group was given a near transposition test and the other half was given a far transposition test.

In Experiment II only Groups R and A were used. The

procedure in this experiment was the same as for Experiment I except for several procedures designed to orient *S* to the weight dimension in the discrimination learning task and to facilitate transfer of the name learned in pretraining to the learning task.

The results of both experiments indicate that there was no significant difference between groups in learning the pretraining task. On the discrimination learning task Groups R and A were not different from each other, but both were superior to Group N. In the transposition test Group R performed significantly better than Groups A and N, that is, Group R transposed more. Groups A and N were not significantly different. Learning took place in the transposition task, but not differentially between groups. In Experiment I *Ss* given a near transposition test performed significantly better than *Ss* given a far test. This difference was not significant in the second experiment. These results support the hypothesis that children given pretraining with a meaningful relational name will perform better on a transposition test than children given pretraining with an absolute nonsense name or children given no pretraining. The results were discussed in relation to other transposition studies using infrahuman *Ss* and children.

Microfilm \$2.50; Xerox \$3.00. 54 pages.

#### AN EXPERIMENTAL INVESTIGATION OF THE DIFFERENTIAL EFFECTS OF HYPNOTIC, POST-HYPNOTIC AND WAKING SUGGESTION ON LEARNING, WITH TASKS VARIED IN COMPLEXITY.

(L. C. Card No. Mic 60-4679)

Herman Carl Salzberg, Ph.D.  
The University of Tennessee, 1960

Major Professor: W. O. Jenkins

An investigation was undertaken to ascertain whether there are any differential effects of hypnotic, post-hypnotic and waking suggestion on the learning of tasks varied in complexity. A fairly comprehensive review of the literature on hypnosis was made. Special emphasis was placed on studies that dealt with hypnosis and learning and critical evaluations were made of them.

Two experiments were carried out, the second a replication of the first with slight modifications. Thirty-five university sophomores were used as volunteer subjects. They were placed in four groups, namely, hypnotic (*N* equals 10), post-hypnotic (*N* equals 10), waking suggestion (*N* equals 11), and normal waking group (*N* equals 4). The first three groups were seen previous to the experiment proper. The hypnotic and post-hypnotic subjects were put through a systematic hypnotic procedure and were retained as subjects if they were able to achieve post-hypnotic amnesia and carry out a post-hypnotic suggestion. Approximately 50 per cent of subjects tested satisfied these criteria. The waking suggestion group did not go through the hypnotic procedure but were seen for the same amount of time. The normal waking group was not seen before the experiment proper.

During the experimental session four series of tasks were administered with the normal waking state and



suggestion state counterbalanced. Each series consisted of three tasks. The least complex task was a counting task. The task of medium complexity was a memory task. The most complex task was an abstraction task. The hypnotic group learned the tasks twice in the normal waking state and twice under hypnosis following a suggestion of increased efficiency. The post-hypnotic group learned the tasks twice in the normal waking state and twice in the taking state following post-hypnotic suggestion. The waking suggestion group learned the tasks twice in the normal waking state and twice in the waking state following waking suggestion. The normal waking group learned the tasks all four times in the normal waking state without suggestion. Measures of quality and quantity of learning were obtained on each task for each subject.

The major finding was that the hypnotic and post-hypnotic groups improved significantly following suggestion. The waking suggestion group learned significantly less following suggestion. The normal waking group learned approximately the same amount on all four series. This was true for all three tasks and for both experiments. There was no significant difference in improvement across tasks. There was a tendency for suggestion to yield greater improvement in quantity of learning than quality of learning for the hypnotic and post-hypnotic groups although both measures were significantly higher following suggestion than in the normal waking state.

Scores on the three tasks in the normal state were not significantly correlated which suggests that each task measures a different capacity. Improvement following hypnotic and post-hypnotic suggestion was not correlated with performance in the normal waking state which indicates that amount of improvement is not a function of initial ability. Scores for the quantity measure were moderately correlated with scores for the quality measure both in the normal waking state and in regard to amount of improvement following suggestion.

The theoretical implications and practical applications of the findings were discussed, and proposals were made concerning further research in this area. Emphasis was placed on the need for rigorous controls in experimental design and hypnotic technique.

Microfilm \$2.50; Xerox \$7.80. 169 pages.

**VISUAL PERCEPTUAL PATTERNS  
AND THEIR RELATION TO  
READING: A STUDY OF ONE  
HUNDRED FIRST GRADE CHILDREN.**

(L. C. Card No. Mic 60-6425)

Hazel Gantt Seigler, Ph.D.  
University of South Carolina, 1960

Research has shown that adequate visual efficiency is prerequisite to skill in perceiving printed symbols and that a certain level of mental ability is required for comprehension. Various methods of teaching reading have been compared, but no one method appears to meet the needs of all students, especially at the first grade level. Reading authorities have been unable to explain why some children who appear to have the necessary potentials for the process involved in learning to read make very slow progress in developing reading skills.

Marked differences have been observed in the degree of maturity of readiness skills, as measured by readiness tests, among children in any given first grade group. Readiness tests are not always reliable predictors of reading readiness even though they usually show results that correlate highly with results of intelligence tests. Although recent research shows that a certain level of visual perceptual ability is requisite for the initial stages of reading instruction, intelligence tests and readiness tests fail to measure the perceptual abilities of a child. With one exception studies investigating perceptual ability and reading achievement have used subjects who have already received reading instruction.

The problem of this investigation was that of investigating the relationship of visual perceptual ability to reading achievement of first grade children. One hundred children were chosen to take part in the experiment. They represented several levels of socio-economic standing, and were believed to be a heterogeneous group. The subjects were equated on the basis of hearing and vision. They represented an age range of twenty-five months. Within ten days of the beginning of school the subjects were given a mental maturity test and four non-verbal visual perceptual tests. The visual tests were unpublished experimental ones designed by Dr. Thelma Gwinn Thurstone. The subjects were administered the Gates Primary Reading Tests in February and the Advanced Primary Reading Tests in May.

The results of the perceptual tests indicated that there were varying degrees of perceptual competency among the subjects. The results of each perceptual test correlated with reading achievement at the .01 level of significance. The perceptual tests measured four aspects of perceptual skill. The average perceptual score was correlated with chronological age, with mental age, with the February reading scores, and with the May reading scores. The correlation coefficient of perceptual scores and reading achievement was highly significant. Perceptual ability indicated higher relationship to reading achievement than did mental age. The correlation between chronological age and perception was quite low. If the results of the investigation are supported by further research, the findings have significant implications for using a measurement of perceptual ability to evaluate a child's reading readiness, to provide diagnostic information on a first grade child's perceptual abilities, and to help prepare reading instruction appropriate for his abilities.

Microfilm \$2.50; Xerox \$5.00. 98 pages.

**SOME TESTS OF A TRANSFER THEORY  
OF ALTERNATION BEHAVIOR**

(L. C. Card No. Mic 60-5254)

Jerome Smith, Ph.D.  
The University of Connecticut, 1960

Estes and Schoeffler have proposed that the phenomenon of alternation after forced trials is a function of transfer of training. The training involved is based upon a correlation between likelihood of reinforcement and recency of visit to a location, a correlation produced by the feeding history of the rat.



The transfer hypothesis was tested directly and indirectly. The direct tests involved attempts at experimental manipulation of the reinforcement-novelty correlation. In one experiment rats were fed by scattering food about the floor of the cage and watered through the nozzle of a bottle always found in one place. The food-novelty correlation was positive while the water-novelty correlation was negative. In a second experiment the food-novelty correlation was maximized for one group of rats and minimized for another. A third experiment dealt with the building of a punishment-novelty correlation, the coupling of shock with new places, designed to interfere with the tendency to seek food in new places.

Indirect tests were based upon inferences made about the effects of drive and extinction upon alternation when it is considered a habit. The hypotheses generated were that lowered drive level should produce a decrease in alternation, and that repeated absence of a reinforcer on the alternated side should produce evidence of extinction.

Alternation testing in all the experiments reported consisted of five or ten forced trials to one side of the maze followed by one free choice. The findings of the direct and indirect tests are as follows:

1. The different correlations between novelty and reinforcement as determined by the nature of the reinforcer (food or water) did not affect alternation after forced trials on a T-maze.
2. Maximizing the food-novelty correlation by means of manipulation of long-term feeding history and short-term open field maze training produced significantly more alternation than was found when the correlation was minimized. The difference was reduced when forced trials were increased from five to ten.
3. Conditions designed to produce a correlation between novelty and punishment did not affect alternation on the T-maze.
4. Attempts to assess the relative importance of long-term and short-term training in the maximizing of the food-novelty correlation were unsuccessful.
5. Lowering of the drive level not only did not decrease alternation behavior, but actually increased it when drive was manipulated during extinction.
6. Alternation did exhibit response decrement characteristic of extinction, although the rate of decline was very slow.

The success of the maximizing and minimizing of the food novelty correlation, and the obtaining of an extinction function provided some degree of confirmation for the transfer hypothesis. The failure to find any differences in the shock-novelty study or the differential reinforcer study, and the reversal of the prediction in the drive study allowed negative inferences concerning the adequacy of the hypothesis. It was possible to justify the negative results to some extent, but only by the adoption of special assumptions.

On the basis of the evidence it was concluded that the transfer of training hypothesis for alternation after forced trials, while worthy of consideration and further investigation, left much to be desired.

Microfilm \$2.50; Xerox \$3.80. 68 pages.

# A DEVELOPMENTAL STUDY OF COMPASSION AND TACT AMONG INTELLECTUALLY BRIGHT AND RETARDED MALES

(L. C. Card No. Mic 60-4727)

Paul Solomon, Ph.D.  
Clark University, 1960

Supervisor: Tamara Dembo

Many authors have felt that retarded persons are limited in their interpersonal relationships concomitantly with their intellectual retardation. Others have stated that there is no necessary connection between intellectual ability and ability in interpersonal relationships. One of the major reasons for this disagreement has been that little distinction is made between the intellectual and emotional aspects of interpersonal relationships. Various interpersonal relationships involve different degrees of cognitive and emotional abilities. It is the contention of this study that bright persons will do better than retarded persons in those interpersonal relationships which require intellectual components of a higher order; whereas retarded persons will be like bright persons in responding to interpersonal situations where intellectual factors are of lesser importance.

This study investigates the developmental problem of cognitive and emotional factors pertaining to interpersonal relationships. The interpersonal relationships of "compassion" and of "tact" were selected for this investigation. Compassion is representative of interpersonal relationships in which intellectual activity is of lesser importance. It is primarily a feeling relationship in which one person shows sympathy for another person in a distressing situation. Tact is representative of interpersonal relationships requiring more complex intellectual capacities; specifically tact requires that a person figure out a resolution of a conflict between the necessity for doing a potential hurt and the desire not to hurt another person.

Sixty-nine retarded males, ages 6 to 59, and 81 bright males, ages 3 to 48, were subjects of this study. The method consisted of presenting subjects with six open-ended stories in a setting of free conversation. Three of these stories were written to evoke compassionate responses and three to evoke tactful responses. The completions of the stories were scored in regard to compassionate and tactful responses respectively.

It was found that there is a definite developmental trend among bright males in the ability to give compassionate responses. The youngest subjects gave both hurting and compassionate responses; but by age 6 all the bright subjects consistently gave compassionate responses with increasing age, bright subjects were able to give comparatively more alternative compassionate responses to the compassion evoking stories.

The youngest retarded subjects gave both hurting and compassionate responses; by age 7 all retarded subjects consistently gave compassionate responses. Thus, at age six the bright subjects gave significantly more compassionate responses than the retarded subjects. From age seven on, there was no difference between bright and retarded subjects with regard to the frequency and consistency of compassionate responses. However at all age levels between six and twelve the bright subjects gave significantly more alternative responses than the retarded subjects.



In responding to the tact-evoking stories, bright subjects characteristically gave tactful responses. In contrast, the retarded subjects usually gave avoidance responses. "Avoidance" responses are defined here as those in which the subject solves the conflict by completely avoiding the hurting task set up in the open-ended story. The avoidance responses are primarily based on feelings whereas the tactful responses require more intellectual ability. The difference between the bright and retarded subjects with respect to avoidance and tactful responses approaches statistical significance at all age levels. In situations calling for tact, both bright and retarded subjects attempted to give solutions which, in general, spare the feelings of another person, but the way of doing this differs between the two groups.

Where mainly the feeling aspects of interpersonal relationships are involved, the retarded subjects come quite close in their responses to those of the bright subjects. However, where intellectual capacities enter into the formation of interpersonal relationships, the responses of the bright subjects are superior to those of the retarded.

Microfilm \$2.50; Xerox \$6.20. 128 pages.

**EFFECTS OF VARIATIONS IN  
REARING AND DRIVE  
LEVEL ON RESPONSE PROBABILITY IN  
CONTINGENT AND NON-CONTINGENT  
PROBABILITY LEARNING TASKS**

(L. C. Card No. Mic 60-5255)

Stuart Solomon, Ph.D.  
The University of Connecticut, 1960

In probability learning tasks subjects make repeated choices between two or more alternatives, when the probability of reward on each alternative is greater than zero but less than one. Under some circumstances subjects respond to each in proportion to the frequency it has been rewarded ("matching" solution). In other cases subjects approach 100% choice to the one more frequently reinforced ("maximizing" solution). An attempt was made to test two theories, both using the effects of previous training to account for which solution is adopted. Estes suggests that animals reared under irregular and changing reinforcement schedules will "match." Animals reared with unchanging reinforcement schedules will "maximize." Goodnow predicts that animals reared with irregular reinforcement will maximize, and those who had constant reinforcement will match. Testing these two opposite predictions implies testing also the basic assumption that response probability is dependent upon previous training.

Differential treatment was given 24 constant-reared (C) and 22 variable-reared (V) male albino rats on the following variables from birth on: a) Number of foster mothers and litter size, b) Feeding schedules, c) Drinking schedules, d) Cage location, e) Number and identity of animals in each cage, f) Opportunity for sexual experiences, g) Variability of available light. The V group was reared with randomly varying schedules for each of these variables, little in their environment being stable. The C group had unchanging schedules, and thus a stable environment. Half of each of the two groups was run after 45 days of

rearing, the remaining animals after 90 days. A single choice-point, alley T-maze was used, with a 75%-25% reinforcement schedule. Eight trials were run daily, for a minimum of 144 or a maximum of 208 total trials.

Theoretical and empirical reasons exist for assuming that both drive level and training procedure may affect response probability in a partial reinforcement situation. The C-V and duration treatments were further subdivided, by factorial design, into High and Low Drive, and Correction and Non-correction running groups. Since the V group was probably operating under higher drive, it was necessary to find out if this contaminating factor was relevant to asymptotic response probability.

Drive level proved to be the single most important variable. High drive pushed response level toward maximizing. Low Drive animals tended to match. The differences between drive level groups were of the same magnitude as those between rearing groups.

All V groups reached significantly higher asymptotic response levels than the C groups. The V group approached the 100% or maximizing level, while the C group approximated the 75% or matching level. When the relevantly contaminating effects of drive, as measured by running time and by weight, were removed by covariance analyses, significant differences attributable only to rearing effects still remained. Only one significant effect of duration or rearing appeared. The early-tested C group responded at a higher asymptotic level than those late-tested.

Correction and non-correction training procedure showed only interaction effects with the other variables.

Because the V rearing led to higher asymptotic levels of response, the results are consistent with Goodnow's theory, and inconsistent with the prediction of Estes. Both theories were found to be deficient in not provided a place for drive as a crucial determiner of asymptotic response level. Whether Ss maximize or match depends on both rearing and drive level factors. Since drive level and incentive have been found to have similar effects, the view is supported that they are experimentally the same operations.

Microfilm \$2.50; Xerox \$5.80. 119 pages.

**STIMULUS CONTIGUITY: AN INVESTIGATION OF  
OPERANT DISCRIMINATIVE EFFECTS OF  
SIMULTANEOUS PRESENTATION OF  
STIMULI IN TWO MODALITIES.**

(L. C. Card No. Mic 60-5173)

Walter Beekman Studdiford, Ph.D.  
University of Minnesota, 1960

Adviser: Dr. Kenneth MacCorquodale

It was hypothesized that contiguous occurrences of two stimuli would make them discriminatively equivalent, so that an operant response associated discriminatively with one (the "primary stimulus," or "S<sub>1</sub>") would as a consequence transfer to the other (the "secondary stimulus," or "S<sub>2</sub>").

Two experiments were done with rats 23-hours food-deprived. Following preliminary bar-press training, each experiment consisted of three stages: (I) simultaneous pairings of S<sub>1</sub> and S<sub>2</sub> for experimental animals, and

presentations of either  $S_1$  or  $S_2$  alone for control animals, (II) reinforced training with  $S_1$  as discriminative stimulus for bar-pressing, and (III) presentations of  $S_2$  to determine its discriminative powers to evoke bar-pressing--first by extinction and then by discriminative retraining. For half of the animals stage II came before stage I. The two experiments differed with respect to whether reinforced responses could occur during stage I. In Experiment I stimuli were paired with food reinforcements given following bar-presses made during these pairings; in Experiment II stimuli were paired while subjects were behind a wire-mesh barrier and hence unable to bar-press or to receive food reinforcements. Daily sessions were 30 minutes in duration. Presence of a stimulus (simple or compound) regularly alternated with its absence at 30-second intervals. During stage I, ninety 30-second stimulus presentations were made. Subjects were trained to bar-press discriminatively under a multiple schedule of reinforcement and extinction with presence of a stimulus as  $S^D$  and its absence as  $S^\Delta$ . The dependent variable measures of response strength were total presses per session and "discriminative ratios" ("DR's") per session;

$$DR = \frac{S^D\text{-presses} - S^\Delta\text{-presses}}{S^D + S^\Delta\text{-presses}}$$

Experiment I was completed with 12 animals in a 2 X 3 factorial design. Light and buzzer were counterbalanced as  $S_1$  and  $S_2$ . Treatments of no-stimulus-pairing ( $P_0$ ), early-stimulus-pairing ( $P_1$ ), and late-stimulus-pairing ( $P_2$ ) were given. It was hypothesized that (1)  $S_2$  would gain some discriminative properties, (2) light and buzzer might differ in discriminative powers, and (3) time of stimulus pairing might influence the degree to which  $S_2$  would acquire discriminative properties.  $S_2$  did acquire some discriminative power, as shown by higher DR's during extinction for  $P_0$  animals than for  $P_1$  or  $P_2$  animals.\* Light and buzzer did not differ significantly in their discriminative powers.  $P_0$  animals made more bar-presses during extinction than  $P_1$  animals did. On the second day of retraining  $P_1$  animals made fewer presses than  $P_2$  animals.

Experiment II was also completed with 12 animals in a 2 X 3 factorial design. Buzzer was made  $S_1$  and light  $S_2$ . One treatment dimension was time of barrier training: early ( $P_1$ ) versus late ( $P_2$ ) (preconditioning versus "post-conditioning"). During stage I, for experimental subjects (E)  $S_1$  and  $S_2$  were paired simultaneously; one control group ( $C_B$ ) was presented with  $S_1$  alone; the other control group ( $C_L$ ) was presented with  $S_2$  alone. It was hypothesized (1) that time of barrier training might influence stimulus-contiguity effects, and (2) that for group E,  $S_2$  should acquire some discriminative properties. On the extinction test  $P_1$  animals made more bar-presses than

$P_2$  animals. On the second day of retraining E and  $C_L$  animals both pressed more than  $C_B$  animals. That day E animals also had higher DR's than  $C_L$  animals. Rather than clearly confirming or disconfirming the hypothesis that contiguity of stimuli produces a transfer of discriminative properties from one to another, these differences suggested that a build-up of inhibitory potential could have occurred during the barrier sessions for the stimulus or stimuli then presented.

\*Differences noted here are significant at the 5% level as determined by analysis of variance and Scheffé comparisons. Microfilm \$3.10; Xerox \$10.80. 239 pages.

### THE CORRELATES OF VISION LOSS IN THE ADULT BLIND

(L. C. Card No. Mic 60-6135)

Robert John Teare, Ph.D.  
Purdue University, 1960

Major Professor: Dr. Joseph Tiffin

The objectives of this research were to: (1) determine the influence of remaining vision on the factor structure of a battery of aptitude tests, and (2) evaluate the effects of three early experience parameters (vision level, onset age, parental occupation level) on the adult job achievement of the legally blind.

The factor analysis study utilized three groups of visually disabled persons. There were 97 individuals in the High Vision group, 147 persons in the Mid-Vision group, and 206 persons in the Low Vision group. Vision level ranged from 80 per cent loss to total blindness.

A principle components factor analysis was carried out at each of the three vision levels. Each analysis gave three factors. The structure of these factors changed systematically as vision decreased.

The analysis of adult job achievement involved a 3 x 3 x 2 factorial unweighted means analysis of variance. A sample of 440 individuals was used. The treatments consisted of three levels of vision loss, three levels of parental occupation, and two onset age levels. The analysis revealed a complex pattern of interactions among the three treatments. Vision loss affected job achievement; the lowest level of attainment was in the Mid-Vision group. The offspring of high achieving parents attained higher job placement than either of the other two groups. Onset age differences were obscured because of differential influences of parental occupation and level of remaining vision.

Microfilm \$2.50; Xerox \$4.80. 94 pages.



## RELIGION

### SACRIFICE: A COMPARATIVE STUDY OF THE CONCEPT IN ST. GREGORY OF NYSSA'S CONTEMPLATION ON THE LIFE OF MOSES AND SHRI AUROBINDO'S COMMENTARY ON THE VEDA.

(L. C. Card No. Mic 60-5821)

Allan W. Anderson, Ph.D.  
Columbia University, 1960

The purpose of this study is to show systematically how sacrifice, both as idea and act, is approached by two widely separated thinkers, namely, St. Gregory of Nyssa and Shri Aurobindo. Both apply a similar exegetical approach to their respective scriptural sources while developing a common theme: sacrifice viewed paradigmatically as journey, battle and ascent. This common method is offered as the "control" internal to this study. It is on the basis of this paradigmatic structure that the similarities in difference between Gregory and Aurobindo are examined. Chapter I explains this purpose and approach.

Chapter II examines Gregory's approach to sacrifice through his relating the life of Moses to Christ's Passion. The chapter's three divisions comprise: 1) Gregory's textual adductions from Scripture and his commentary thereon; 2) his general interpretation of sacrifice, in the Contemplation, understood as journey, battle and ascent; 3) the Divine, Divine-human and human interrelationships and activities in sacrifice conceived as journey, battle and ascent.

Chapter III introduces and criticizes some Western theories of Vedic sacrifice. The following three sections are structurally comparable with Chapter II, following the same pattern: 1) Aurobindo's textual adductions from Scripture and his direct commentary on them. Here a linguistic critique is advanced by comparing Aurobindo's translation of the Rg Veda with Geldner's; 2) Aurobindo's interpretation of the Rg Vedic conception of sacrifice as journey, battle and ascent; 3) the Divine, Divine-human and human activities in the sacrifice and conclusion.

Chapter IV divides also into three sections: 1) a textual comparison of key concepts and images in order to show what is textually fixed in the way of cardinal elements in both commentaries; 2) similarities and differences in the treatment of sacrifice as journey, battle and ascent; again, the Divine, Divine-human and human initiatives brought forward and related to the concepts power, light and beatitude; 3) the essential doctrinal differences between Gregory and Aurobindo compared, concluding with a reflective statement on the significance of the study for further metaphysical enquiry.

In particular it is suggested that the poetical and religious categories of journey, battle and ascent have respective metaphysical equivalents in the concepts process, encounter and correspondence -- the latter whether in terms of likeness (image) or identity. A religious meta-

physic grounded in sacrifice so paradigmatically conceived might claim the advantage of wider and deeper insight into the basic unity of the person and his world instead of tending to emphasize one problem, or category, at the expense of others. Whether such a metaphysic is possible or no, Gregory and Aurobindo invite us to a whole vision of man and his world. Within the focus of their respective religious traditions, both thinkers would relate men to the Divine through a union of infinite potential for the world's and man's transfiguration.

Microfilm \$2.50; Xerox \$7.60. 163 pages.

### THE DEFINITION OF THE EPISCOPAL OFFICE IN AMERICAN METHODISM

(L. C. Card No. Mic 60-5302)

Jesse Hamby Barton, Jr., Ph.D.  
Drew University, 1960

The purpose of this study is to explicate the thinking of the Methodist church in America regarding its episcopacy. The time limits are 1784 to 1939. Some material prior to 1784 had necessarily to be considered, and some comments have been made on the period after 1939. The study is confined to the Methodist Episcopal Church, the Methodist Episcopal Church, South and The Methodist Church.

The method of study has been an exhaustive examination of all relevant material. Weight has been accorded to the official actions of the church and its episcopacy. The study has been divided into two parts, historical analysis and doctrinal conclusions. But a strict separation of these parts has not been maintained.

The foundation of Methodist episcopacy is the action of John Wesley in ordaining and sending Thomas Coke as his agent to organize the Methodist societies in America as an independent episcopal church. The societies, through their preachers, assembled in the Christmas Conference of 1784, accepted this new organization and by a vote recognized Coke and Francis Asbury as their superintendents or bishops. In 1787 the Conference of preachers rejected the political authority of Wesley and thenceforth exercised the whole authority of the church.

Strictly, Wesley and Asbury are to be considered as founders of the church, not as regular bishops. Thus they possessed a measure of authority not accorded other bishops. The regular constitutional episcopacy began with the tenure of William McKendree (elected 1808).

The division of the church in 1844 involved the doctrine of the episcopacy. The Methodist Episcopal Church held a doctrine of the supremacy of the General Conference over the episcopacy. The Methodist Episcopal Church,

South held the episcopacy to be an independent institution coordinate with the General Conference. The reunion of 1939 was a compromise between these views.

Doctrinally, the church bases its authority solely on Scripture. It recognizes the divine appointment of a ministry by Scriptural authority. But from the absence of a specific pattern of organization in Scripture it claims freedom to organize its polity according to the particular need of the church. Thus the church has chosen its episcopal polity and retains authority to modify it.

The primary order of the Methodist ministry is its presbytery. Its other ministries, the deaconate and the episcopacy, are not different in kind from the presbytery. The deaconate is in practice a temporary order preparatory to the presbytery. The episcopacy is a representative order to which is delegated functions which are essentially presbyterial, but cannot be performed by the presbytery as a whole and are therefore delegated to the bishops as representative presbyters. Thus the Methodist ministry is one order with two suborders.

Methodist episcopacy is essentially different from the "historic episcopacy" where the presbytery is spiritually dependent on the episcopacy; Methodist episcopacy is dependent on the presbytery.

The functions delegated to the episcopacy are the ordination and stationing of the ministry, to which the bishop is pastor pastorum. In addition the episcopacy is an executive instrument of the General Conference and a means of unity within the church.

Microfilm \$3.15; Xerox \$11.05. 243 pages.

THE FORM OF A SERVANT:  
A STUDY OF THE KENOTIC  
CHRISTOLOGIES OF THE  
NINETEENTH CENTURY.

(L. C. Card No. Mic 60-4354)

Donald Gilbert Dawe, Th.D.

Union Theological Seminary in the City of New York, 1960

The theme of the divine self-emptying or kenosis in salvation has been used in two different ways in Christian thought and worship. It has functioned as a broad religious motif. And it has formed the basis of a formal Christological theory. As a religious motif kenosis is descriptive of God's act in Christ and is used to illumine practical problems of the religious life. This is its setting as found in the New Testament and in much Christian literature. As a formal Christological theory kenosis has been used to interpret the person of Christ in a systematic and apologetic manner. These kenotic theories of Christology were the work of certain nineteenth century, mediating theologians who sought a principle of intelligibility for relating the orthodox Christological doctrine to the newly emerging philosophical and religious consciousness of their time. The problem was how to account for the reality of Jesus' humanity as a historically conditioned and naturally developing personality and still retain the reality of his divine nature. They used the kenotic theme as the way of preserving and uniting both the humanity and divinity of Jesus. These theories represent both a translation and a transformation of the earlier motif.

Gottfried Thomasius, the originator of modern kenotic theory, interpreted the Incarnation as the assumption of flesh by the Logos which was possible because of a self-limitation or kenosis of the Logos. The kenosis mediated the assumption of flesh by the Logos in such a way that the man Jesus Christ while truly divine had a unified human consciousness that developed naturally. This was possible because the Logos had emptied itself of the relational attributes of God - omnipresence, omnipotence, omnipresence - which would vitiate the uniquely human element in Jesus' personality. However, the Logos retained the intrinsically divine attributes of truth, holiness, and love which can be expressed in and through a truly human person. But this interpretation of the kenosis as the loss of certain divine attributes endangered the unity and impassibility of God and left insoluble problems for the doctrine of the Trinity. These problems were only heightened by other interpreters of the kenosis, such as W. G. Gess and F. Godet, who insisted that there was a complete emptying of the divine attributes in order to insure the reality of Jesus' humanity. They were left with the problem of just what a completely self-emptying Logos really was.

To solve these problems other interpreters of kenosis theory, such as J. H. A. Ebrard and H. Martensen, described the kenosis not as an emptying or loss of attributes but their transformation. These writers said that kenosis meant the divine attributes of the Logos took on a form compatible with human life. But this did not really solve the problems for the doctrine of the Trinity. It still left the world-ruling functions of the Trinity unattended during the earthly life of Jesus, unless a dual life was predicated for the Logos. Also making the Logos the basis, in some sense, of a human personality endangered the reality of Christ's human nature. So the attempt to build an all-embracing Christological theory on the basis of the kenotic metaphor failed because it posed insoluble problems when used as a means of explicating and rationalizing orthodox doctrine. The kenotic theories of Christology lost their influence in Continental theology by 1886.

The kenotic metaphor continued to be influential in Christological thinking in the English-speaking world. But the English writers, particularly Gore and Forsyth, did not develop complete, systematic Christologies. Forsyth actually asserted the importance of the kenosis theme in spite of its systematic problems. It was not a principle of intelligibility but a basic motif of the faith. Forsyth marks the end of the theological development that took kenosis from a motif and translated it into a formal theory. Kenotic theory became again kenotic motif.

The future use of the kenotic theme depends on placing it into new settings. It cannot be used as a means for describing the possibility of the Incarnation except as it is known in the reality of the witnesses to the Incarnation. The kenosis is an expression of the freedom of God in its most radical dimensions - namely, in God's freedom to become man and yet not be unlike himself.

Microfilm \$3.50; Xerox \$12.40. 272 pages.



**LEVELS OF RELEVANCE IN PREACHING:  
A HISTORICAL STUDY OF THE  
COMMUNICATION OF THE WORD TO THE  
WORLD BY A WITNESS, WITH SPECIAL  
ATTENTION TO THE PRINCIPLES OF  
INTERPRETATION USED IN THE PREACHING  
OF PHILLIPS BROOKS FROM 1859 TO 1892.**

(L. C. Card No. Mic 60-4355)

Norman Bruce McLeod, Th.D.  
Union Theological Seminary in the City of New York, 1960

This thesis tries to examine the predicament of the preacher as he attempts to speak words that will be both coherent to his hearers and faithful to the historic Gospel. The discussion is developed not in abstract but by examining a specific example in some detail--the preaching of Phillips Brooks. Brooks was chosen because his period is far enough away to provide sufficient perspective and near enough to be connected with our own time, and because there is available no recent critical examination of this important representative of American nineteenth century Christianity.

After consideration of the Biblical understanding of the preacher as a subordinate communicator, a potential instrument in the hands of a God who would speak, the temporal situation in which Phillips Brooks lived, and the particular needs and longings to which he spoke relevantly are described in detail. Various levels of relevance among his fellow preachers are then pointed out. Some, under the stress of the situation, thought not of relevance but of fidelity to the historic Gospel, and, ironically, in their incoherence were unfaithful to the direction of that Gospel. Others were so anxious to speak a meaningful word to the temporal situation that they ended unconsciously reflecting that situation. Brooks tried to tread the slippery ground between these two extremes.

The means by which Brooks achieved his relevance are then examined. His methods are described and two of his sermons--one never before published--are analyzed in detail. An attempt is made to give theological form to his preaching. His aim was not to protect the Gospel from the world, but to take out its healing power to a people who needed to be healed. His loyalty to the Episcopal Church in which he worked proved a safeguard against distortion of the Gospel. His handling of the Bible, however, the record of the witness to God's saving communicating activity, is seen to be the door by which many assumptions and surface solutions of his temporal situation were taken unconsciously into the very texture of the Word he preached. Yet, it is concluded, he did prove a useful instrument in God's hand.

It is further concluded that the modern preacher can best resolve his predicament by giving himself to the direction of the Gospel. He must, in other words, strive to communicate, and not be content to wrap himself in irrelevance. Neither, however, can he be content to remain on a shallow level of relevance, but must use every means to uncover the deepest needs of the temporal situation in which he and his people live. Interpretation of the Bible in which men witnessed to a God who would deal with precisely those needs must be his constant task. Never will he know how faithful he has been or at what level of relevance he has been speaking. Having done all he can to be a useful instrument, the result is left finally

in the hands of "an urgent God" whose Word will not return to Him empty.

Microfilm \$6.25; Xerox \$22.05. 490 pages.

**THE SINAI COVENANT TRADITIONS  
IN THE CULT OF ISRAEL**

(L. C. Card No. Mic 60-4356)

Murray Lee Newman, Jr., Th.D.  
Union Theological Seminary in the City of New York, 1960

This thesis is a study of the J and E covenant traditions found in Exodus 19-24; 32-34. In their present form these two traditions are cult legends which were used in connection with cultic covenant ceremonies. Although they both preserve the memory of the original covenant between Jahweh and his people in the time of Moses, each has been colored by generations of cultic use and has developed a distinctive covenant theology. The E legend (Exodus 19:2b-6, 10-11a, 14-17, 19; 20:18-21, 1-17 [20:22-23:33]; 24:3-8) reflects a kind of "kingdom of priests" covenant theology, in which Jahweh's covenant is directly and fully with all the people. The J legend (Exodus 19:9a, 11b-13, 18, 20; 34:1-4; 33:18-23; 34:5-7; 34:10-28; 19:7-8; 24:1-2, 9-11) reflects a "dynastic" covenant theology, in which the covenant is viewed as being primarily with a particular dynasty (Moses--Aaron--Nadab--Abihu) and only through the dynasty with the people. The historical circumstances which saw the emergence of these two theological emphases occurred at Kadesh and are reflected in Numbers 11, 12, 16.

After the Conquest under Joshua, the E legend was associated with the Ark of the Covenant. In various stages of its oral development it was used in covenant ceremonies at Shechem and Shiloh, when those two sites were successively the cult centers of the twelve tribe amphictyony. Separated from the Ark, it reached its final form at Bethel in the tenth century where it was the cult legend for the festival of Jeroboam.

The J Legend was associated with the Tent of Meeting. It was used as the cult liturgy for a covenant ceremony of the premonarchical six tribe amphictyony at Hebron, where it reached substantially its present form. The priestly dynastic covenant theology of the J tradition inspired the royal dynastic covenant theology which was established in Jerusalem in the time of David.

Microfilm \$5.55; Xerox \$19.60. 434 pages.

**THE SELF-UNDERSTANDING  
OF THE QUMRAN COMMUNITY  
COMPARED WITH THE SELF-UNDERSTANDING  
OF THE EARLY CHURCH**

(L. C. Card No. Mic 60-5304)

William Richard Stegner, Ph.D.  
Drew University, 1960

The purpose of this dissertation is to assess the nature of the relationship between the early church and the Qumran



Community. It is assumed that the methodological procedures used heretofore are defective because they have largely depended on word studies and the comparison of isolated texts from the two bodies of literature. It is necessary, rather, to study the total context in which these passages are set. This context involves the picture that each community had of itself and its function in God's *Heilsgeschichte*. This total context is designated by the term self-understanding.

The thesis is advanced that the key to the self-understanding of the Qumran sect is a typological relationship with the wilderness generation whereby the institutions and personalities of the sect were foreshadowed in the events of the Exodus from Egypt, the wilderness wanderings and giving of the Law under Moses, and the conquest of the land.

In Chapter I the philosophy of history of the sect is found to be based in large measure on the Old Testament. Thus the sect feels itself to be the New Covenant community, the saved remnant, the true and faithful Israel of the end time. However, the distinctive element is the belief in the analogous return of the times whereby figures and events of past periods of history are projected into the eschatological future in which the sect believed itself to be living. Significantly, the wilderness generation was found to furnish the major type. Consequently the wilderness motif plays a major role in the literature. Here the wilderness is understood primarily as a time of testing which the first Israel failed and which the eschatological Israel at Qumran is seeking to pass by its perfect obedience to the Law.

In Chapter II the community is found to look upon itself as a holy army poised for the great eschatological struggle which will result in the reconquest of Palestine and the definitive destruction of all the forces of evil. This final holy war is typologically related to the first conquest of the land under Joshua.

In Chapter III the self-understanding of the sect as a center of Levitical purity and consequently as the true temple of God is explored. The typological relationship here is with the tabernacle in the wilderness and the command of God in Exodus 19:6.

Finally (Chapter IV), the sect is seen to picture itself as a center of knowledge and of new-creation. The knowledge treasured was a knowledge of the Law and its interpretation. The Teacher of Righteousness who promulgates the law anew for the eschatological generation plays the role of a second Moses. Like the Israel of old, the new Israel, because of its knowledge of the Law, stands in a new relationship to God and hence views itself as a new-creation.

In comparing the self-understanding of the early church with that of Qumran many points of similarity were found. The philosophies of history as well as the relationship of both communities to the world is very similar. Both groups felt they were the true temple of God, centers of knowledge of the Godly mysteries, and centers of new creation. However, in the church the centrality of Jesus so transforms these elements that they are oriented around him. The belief of each community that it was standing at the end of God's *Heilsgeschichte* readily accounts for the similar elements in the picture each community had of itself. For example, it was almost inevitable that each community, arising from Judaism and believing the End to be at hand, should view itself as a new-creation.

Thus no borrowing by the church is necessary to account for the similar elements that do exist.

Microfilm \$4.85; Xerox \$17.10. 380 pages.

**A CHRISTIAN CHURCH IN  
A COMMUNIST STATE: THE IMPACT  
OF THE COMMUNIST REGIME ON THE  
THEOLOGY AND LIFE OF THE  
REFORMED CHURCH IN HUNGARY.**

(L. C. Card No. Mic 60-4359)

Aurelia Eva Takacs, Th.D.

Union Theological Seminary in the City of New York, 1960

The object of this thesis, expressed in the sub-title, is approached through analyzing the words and acts of the post-war church leaders; by examining the church-state relationships; and by first indicating and later expounding the resistance of the pastors and laity to the church government.

In the preface the writer's understanding of Communism: a totalitarian world-view with religious overtones, is expounded. Two introductory chapters place the church into the historical framework of the nation throughout the centuries, and describe the post-war years. The Reformed Church in Hungary is examined in four main parts of the thesis: the theological system of the new leaders; life and changes within the church; church-state relationships; and the resistance of the church people. A chapter of comparisons and conclusions closes the work.

The new theology first proclaimed God's judgement to which the only possible answer is repentance. Soon repentance to God became a synonym for acceptance of the total situation. The real basis of this theology was an understanding of history which recognized God's will in the events. Although finding revelation in history was denied, yet secondary causes were disregarded and history seemed to enfold only God's activities, never man's sin which may obstruct the divine will.

The life of the church was completely directed by the new leaders. They alone spoke the "timely," the "prophetic" word of God, and claimed first to have recognized, later to have gifts of grace for leadership. A hierarchy, hitherto unknown to Calvinistic churches, was created which demanded obedience to itself. Presumably, under government direction, home mission work became painfully restricted together with other church activities, save formal church services. The line of preaching was set; it was least obeyed among all regulations. To insure the obedience of the pastors, disciplinary measures and compulsory training courses were initiated.

The Agreement between church and state was signed in 1948. It was never repudiated; however, later legislation went contrary to it; also, under government pressure the church leaders gave up rights guaranteed by the Agreement. The church was also called on to render a positive contribution: to approve Socialism; to carry the banner of the World Peace Movement, and to welcome collectivization. Non-resistance or even silent acceptance was not sufficient; continuous vocal approval was demanded.

The various claims to authority and the need for disciplinary measures indicates the weakness of the church



government and the strength of the resistance which could not be expressed publicly. In the first part of 1956, criticism was first voiced and later even published. Before the October revolt pastors and lay members of the Reformed Church formulated their demands and presented them to the church leaders, but no action followed. During the revolt the split between a very small group of the leaders and the rest of the church people became visible. The leaders were asked to resign, which they did, and new elections to church offices were planned. However, the second Russian intervention annulled the gains and after

a slow and painful process the pre-revolt status quo was reinstated. This is the present situation.

In the concluding chapter, the words of several representative theologians living under or specially concerned with the Communist regimes in the satellite countries (J. Hromadka, J. Hammel, K. Barth) and the life of the larger Protestant churches there are compared and contrasted with the findings of this thesis. Finally, the impact of the Communist regime on the theology and life of the Reformed Church in Hungary is summarized.

Microfilm \$6.50; Xerox \$22.95. 510 pages.

## SOCIAL PSYCHOLOGY

### THE DEVELOPMENT OF AFFILIATION MOTIVATION

(L. C. Card No. Mic 60-4837)

Howard Smyer Gall, Ph.D.  
The University of North Carolina, 1960

Supervisor: Charles E. Bowerman

The existence of regularities in the social origins and consequences of human motives is the major premise of this field study. Those childhood conditions associated with the acquisition of affiliation motivation, and the consequences of this motive for peer relationships are the two research foci. A sociological statement of socialization criteria and a psychological statement of affective motivational development provide the conceptual framework. The above articulate in a research design yielding predictions of associations among affiliation motivation, maternal attitudes and behavior, and the child's interpersonal experiences and peer relationships.

Maternal responses to sixteen attitude items reflect the degree to which mothers encourage their child to maintain extensive interpersonal relationships, a class of attitudes termed stress on interpersonal involvement. Responses to twenty additional attitude items reflect the degree to which mothers are accepting of their children and their own role, a second class of attitudes termed maternal acceptance. Responses to two, eight item checklists reflect the number, type (reward or punishment), and affective intensity of maternal sanctions, three classes of disciplinary behavior termed maternal discipline. Maternal responses to a rating scale reflect the degree to which mothers see their child as successful in realizing interpersonal expectations, a class of children's experiences termed confirmation of expectations.

Children's ranking of classmates reflect the degree to which they accept their peers and are accepted by them, two classes of peer relationships termed peer acceptance and acceptance by peers, respectively. Imagery in stories written in response to thematic apperception cues reflects the degree to which children desire to establish, maintain or restore intimate interpersonal relationships, a class of needs termed need for affiliation. The strength of three dimensions of this need, total, goal-oriented and threat-

oriented affiliation motivation, are based on total affiliation imagery, positive (approach) imagery, and negative (avoidance) imagery, respectively.

Classroom procedures administered to 196 fourth or fifth grade public-school children and a home interview of their mothers provide data for testing predictions of direct association between total affiliation motivation and each of the above six variables.

None of these six relationships is supported by the data. Analysis in which motive strength is based on approach and avoidance imagery, however, confirms three original predictions; a significant association exists between stress on interpersonal involvement and threat-oriented affiliation motivation, between this motive orientation and peer acceptance, and between number of affective rewards and goal-oriented affiliation motivation. Unanticipated relationships are supported also, yielding a set of empirical results involving confirmation of expectations, maternal acceptance, sex of the child, mother's educational attainment and the two motive orientations.

These results provide evidence in support of the study's major premise and suggest, in addition, the relevance of conflict theory for the investigation of motive development during childhood.

Microfilm \$3.85; Xerox \$13.50. 298 pages.

### CASEWORK RESULTS AMONG MARRIED COUPLES IN CONFLICT: A DEVICE TO MEASURE ATTITUDINAL CHANGE.

(L. C. Card No. Mic 60-5104)

Elizabeth Most, D.S.W.  
Columbia University, 1960

A simple, inexpensive, three-page questionnaire, easily administered by a reception clerk, was devised to reveal pertinent attitudes of clients under casework counseling and to show change or "movement" by repeating the test, which was found to have practical value also in diagnosis and treatment.

The questionnaire consisted of three groups of questions:

42 questions on the extent of satisfaction a wife finds in her husband in six areas -- personality traits and habits, relationship (companionship), sex-relationship, job-household-finances, family (children, in-laws), and activities-interests-friends; -- 22 questions on the extent of friction in the marriage; and a final question about happiness in the marriage. Replies were requested on a four-point scale (from very satisfied to very dissatisfied, from very much friction to none at all, and from very happy to very unhappy).

The questionnaire was routinely administered in the Marriage Consultation Service of the Margaret Sanger Research Bureau to 141 consecutive presenting married women clients seeking help with marital problems, until 20 cases of marital conflict had received five or more counseling interviews. At the end of the final interview the wife was given the questionnaire a second time; and six to eight months later a third set of replies to the same questionnaire was obtained by a mail follow-up from 14 of these wives.

The 20 case histories of these clients were judged by the caseworker independently of the questionnaire, and were submitted to qualified professional judges for independent ratings by the C.S.S. (Hunt) Movement Scale, and by Philadelphia Marriage Council's Case Analysis Schedule (a special modification of the Schedule restricted to movement items).

A control group of 20 unselected women patients of the Fertility Service of the Sanger Bureau was also given the questionnaire upon admission and again after an interval of three months, which was the average length of counseling treatment for the 20 Marriage Consultation Service clients. The control and the counseled group were both urban, fairly youthful, well-educated, and economically stable, and had come voluntarily on a fee-paying basis for help with a family problem.

The questionnaire replies were found to reveal the clients' subjective evaluation and their awareness of change, and to demonstrate that movement had occurred and had been sustained over a period of months. Comparison with the control group indicated that improvement was related to counseling. Client self-evaluations did not correspond significantly with existing measuring scales although correlation between clients' and caseworker's evaluations was high, as was that between all three professional judgments, each using different criteria. The C.S.S. and Philadelphia Movement Scales, not previously compared, showed fair agreement.

The result of the study suggests that an important goal of marriage counseling is to stop the spread of tangible problems (sometimes insignificant in themselves), into the feeling areas of the relationship, and to re-establish bridges of communication between the partners. The questionnaire can be used to distinguish between conflict and non-conflict cases, to compare caseloads or casework processes in various settings, and to determine length of treatment, and it could be adopted for other uses.

Detailed discussion of a sample case and observations on the entire group of clients illustrate these conclusions.

Microfilm \$2.50; Xerox \$6.00. 124 pages.

## ADOLESCENTS' ATTITUDES TOWARD ACADEMIC BRILLIANCE

(L. C. Card No. Mic 60-5115)

Abraham J. Tannenbaum, Ph.D.  
Columbia University, 1960

Chairman: Goodwin Watson

This inquiry compared adolescents' attitudes toward two types of high school students, one reputedly "brilliant" and the other "average" in ability. It further sought to ascertain whether possible differences in reaction to such types of students are stimulated by these contrasting ability characteristics independently or through interaction with certain other personal attributes. Also investigated was the degree to which teenagers' intelligence and parental education correlate with their acceptance ratings of the academically brilliant.

Written descriptions of stereotyped fictitious students were prepared. Every imaginary character was portrayed in three sentences, each exposing one of two contrasting attributes. The first sentence alluded to the student's ability (Brilliant or Average), the second to his scholastic effort (Studious or Non-studious), and the third to his sportsmindedness (Athletic or Non-athletic). The three dichotomized characteristics appeared in every possible combination, producing descriptions of eight stimulus characters in all. Beneath each description there appeared a trait list empirically developed from the free reactions of 200 teenagers to the typical "brilliant student" and "athlete." The subjects then indicated for every trait whether or not it typified each of the eight stimulus characters. Obtained thereby was a rating of each character based on the relative frequency with which desirable and undesirable traits were ascribed to him.

The population surveyed consisted of 615 juniors in a large New York City comprehensive high school located in a predominantly Jewish middle-class neighborhood. Estimates of intelligence were secured from a specially developed standardized vocabulary test, and parental education was scaled according to amounts of completed formal schooling. Correlation coefficients were then computed between ratings of the characters and respondents' scores in intelligence and parental education.

On the basis of mean acceptability ratings, the characters ranked as follows:

1. Brilliant-Non-studious Athlete
2. Average-Non-studious Athlete
3. Average-Studious Athlete
4. Brilliant-Studious Athlete
5. Brilliant-Non-Studious Non-athlete
6. Average-Non-studious Non-athlete
7. Average-Studious Non-athlete
8. Brilliant-Studious Non-athlete

Of the four possible comparisons between individual average and brilliant characters matched for effort and sportsmindedness, only that of the Studious Non-athletes revealed a significant mean difference (in favor of the average character). There was no significant difference between the mean ratings of total groups of average and brilliant characters.

In the paired comparisons of non-studious and studious characters matched for ability and sportsmindedness, significant mean differences were found only between the



Brilliant Athletes and between the Brilliant Non-athletes (favoring the non-studious character in each case). As a group, the non-studious rated significantly higher than the studious. Individually and as a group, the athletes rated significantly higher than the non-athletes.

The male and female respondents differed significantly in their ratings of four characters, the females ascribing higher scores in each case. These four characters were divided evenly between brilliant and average but three were non-studious and three were athletes.

Correlations between character ratings and respondents' intelligence and parental education were near zero.

Insofar as verbal stereotypes reflect face-to-face relations, these results suggest that academic brilliance

*per se*, as compared to average ability, is not a stigma among adolescents, but when combined with relatively unacceptable attributes, it can penalize its possessor. The non-studious athlete may demonstrate outstanding brain-power without fearing social derogation by peers. However, a display of brilliance by one who is studious and indifferent to sports constitutes a definite status risk.

Educators should consider the possible effects of these adolescent values upon the gifted youth's desire to excel. The brilliant student may be an exceptionally prominent target for teenage pressures to conform to certain behaviors and values. If so, there is danger of his deliberately masking his talent in order to relieve these pressures.

Microfilm \$2.85; Xerox \$9.90. 218 pages.

## SOCIOLOGY

### SOCIOLOGY, GENERAL

#### FACTORS RELATED TO LEADERSHIP IN A COLLEGE RESIDENCE HALL

(L. C. Card No. Mic 60-5870)

James Gregory Allen, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisor: George M. Beal

The United States is recognized as the strongest proponent of the democratic way of life. This recognition is, in part, due to the leadership shown by the formal leaders of our nation, both past and present. Among the means for the development of such leaders are the colleges and universities in the United States. Residence halls are one of the segments of college life which is providing opportunity for leadership training and development.

The major purpose of this study is to test the hypothesis that there are sociological and psychological variables which provide a basis for differentiating between those who have emerged as formal leaders and those who do not hold these formal leadership roles in the M. R. A. at Iowa State. Leadership is the dependent variable. In this study the leader is defined as that individual who has been elected to a formalized position or given office in his house, the M. R. A. or/and on campus.

Out of a review of literature and sociological and psychological theory, a framework was developed involving nine independent variables. These independent variables are personal characteristics, formal interaction, goal aspiration, norm knowledge and compliance, communication, authority attitude, status perception, identification and relevant primary reference group effect. The dependent variable of leadership was linked with the nine independent variables to formulate nine general hypotheses. Seventeen (17) empirical hypotheses were developed to support or refute the general hypotheses.

Data for this study were gathered from the Men's Residence Halls, Iowa State. The sample of the residence

halls population consisted of equal numbers of residents randomly selected within each academic classification strata. Completed questionnaires were obtained from 120 residents who met the criteria for leaders and 120 residents who met the criteria for non-leaders. Completed questionnaires were also obtained from 39 residents who met the criteria for outside leaders. The outside leader data were used for supplemental analysis. The data were coded and punched on IBM cards for analysis.

The hypothesized differences between leaders and non-leaders were supported by the data on 12 of the 17 empirical hypotheses stated for the nine independent variables developed in this study. Significant differences were found between the leaders and non-leaders in the following measures: ascendance, sociability, intelligence, social participation inside the halls, social participation outside the halls, goal aspiration, norm knowledge and compliance, communication, authority attitude, status perception, relevant primary reference group value on leadership and identification. In all cases the leaders attained higher scores than the non-leaders.

The hypothesized differences between leaders and non-leaders were not supported by the data on five of the 17 empirical hypotheses involving two of the nine independent variables developed for this study. No significant differences were found between the leaders and non-leaders on the measures of general activity, restraint, friendliness, personal relations and social participation during high school attendance time.

Analysis was made of the data obtained from the outside leaders as a supplemental analysis to the primary analysis between the leaders and non-leaders. In general, the outside leaders appeared more similar to the non-leaders than the leaders.

Limitations of the study and suggestions for additional research are discussed.

Microfilm \$2.50; Xerox \$8.60. 190 pages.

PERSONAL AND SOCIAL CHARACTERISTICS  
ASSOCIATED WITH MIGRANT STATUS  
AMONG YOUNG ADULT MALES  
FROM RURAL PENNSYLVANIA

(L. C. Card No. Mic 60-5416)

Claude Harold Brown, Ph.D.  
The Pennsylvania State University, 1960

In recent years a great deal of interest has been shown in the selective aspect of migration. Much of the interest has focused on the question of whether the migration of rural youth has been selective of the more vigorous and able elements of the rural population. The purpose of this study was to ascertain the influence of selected factors which are supposedly related to the migration of rural youth. The variables investigated were intelligence, personality adjustment, parental occupation, marital status, education, and occupation.

In general, earlier studies considered the migration of rural youth to be a categorical phenomenon, movement from rural to urban areas. The position taken here is that migration now involves more specialized movements of people from one farming region to another, from one rural area (not necessarily farm) to another rural area, as well as movement from rural to urban places.

In order to determine the association of the above mentioned factors to migration, data were gathered from 974 young adult males from the rural areas of Pennsylvania. They were initially contacted in 1947, when they were sophomores in rural high schools. An extensive reinterview was made in 1957; at which time the respondents were about 25 years of age. Residence of origin--farm, open country, and village--was statistically controlled at all times. The spatial mobility data were placed in four categories: nonmovers, local movers, rural migrants, and urban migrants. Statistical analyses were made in which the nonmovers were compared with each of the mobility categories within each residence type. From this analysis there resulted a number of findings which were considered of some importance:

1. An examination of the mobility patterns revealed that approximately three-fourths of the young people remained in rural areas while one-fourth migrated to urban areas. Almost one-half of the respondents were in the same community in 1947 and 1957. Of these, nearly fifty percent had not left the parental home. From this it was concluded that there was not a wholesale movement of young adult males from the rural areas of Pennsylvania.
2. Intelligence was not associated with migrant status. There was no difference in the intelligence quotients of those young men who remained in the rural areas as compared to those who migrated.
3. Personality adjustment was not associated with migrant status. This variable had little, if any, influence on the migrant statuses of the young adult males from the rural areas of Pennsylvania.
4. There was no association between migrant statuses of the respondents and the prestige ratings of their parents' occupations. Migrants were just as likely to have come from low status homes as from high status homes.

5. The types of occupations in which the parents were employed had little influence on the migratory behavior of the respondents.
6. Marital status was highly associated with migrant status. There was by far a greater preponderance of married persons in the mobile categories than were single persons.
7. Amount of education, number of years of training, was not associated with migrant status. There was a tendency for those with more education to migrate to urban areas, but the differences were not significant.
8. Type of most recent education was not associated with migrant status. Rural areas tended, however, to retain high school graduates in greatest proportions, but again, the differences were not significant.
9. Prestige ratings of present occupations were not associated with migrant status. Young men who remained in rural areas were employed in occupations of comparable prestige to those who had migrated to urban areas.
10. Type of occupation was related to migrant status only for those respondents who reported farm backgrounds. The greatest source of variation was related to the fact that of those who became farmers, a greater proportion never left the parental home as compared to those who migrated. For those respondents with open country and village backgrounds, the type of occupations in which they were employed had very little, if any, influence on their migrant status.

Inasmuch as there was an unusual lack of agreement among the findings in this study with that reported in previous research, this problem merited special attention. The reason for the lack of significance for the independent variables was felt to be related to the fact that Pennsylvania is a highly urban and industrialized state. Consequently, its rural population has comparatively easy access to urban centers without having to migrate which would greatly modify the migration differentials. Persons living in rural areas of Pennsylvania would, therefore, have less to gain by migrating than would persons living in less urbanized areas. This view leads to the conclusion that, in general, rural people of Pennsylvania would have less need to migrate in order to take advantage of urban facilities. Microfilm \$2.50; Xerox \$6.00. 121 pages.

PROBLEMS OF SOCIAL  
ORGANIZATION OF A NEW  
PSYCHIATRIC INPATIENT SERVICE

(L. C. Card No. Mic 60-4830)

Robert Guy Brown, Ph.D.  
The University of North Carolina, 1960

Supervisor: Harvey L. Smith

Social factors underlying emergent problems of staff conflict, and the process and consequences of corrective



structural change, were studied in a new and developing psychiatric inpatient service in a university teaching hospital. Data were collected by extensive and intensive interviewing and observation of staff and patients, and from records and documents.

Following formulations of Harvey L. Smith, a conceptual framework was developed within which to analyze manifestations of staff conflict. Diagnostic incidents -- social situations which highlight organizational problems -- were employed to illustrate the utility of this framework in accounting for the conflict. Social factors underlying conflict were conceptualized as follows:

(1) Personnel develop "derived needs," frustration of which may lead to conflict. Doctors did not honor occupational therapists' or nurses' claims to performance of important diagnostic and therapeutic functions, thereby frustrating their derived needs for recognition and status-validation and leading to conflictive interaction.

(2) Instrumental goals may become incompatible when different occupational groups define as hindrances functions other than those they were hired specifically to perform. Conflict between staff nurses and the School of Nursing, a structure separate from the Inpatient Service, persisted when certain procedures of the student nurse teaching program were seen to interfere with attainment of the service goal. Senior staff-resident conflict occurred when residents defined service and research goals as incompatible because they perceived a drug experiment to interfere with patients' therapeutic opportunities and to be potentially injurious to some of them.

(3) Inadequate communication, with consequent ambiguous role definitions and incongruent role-expectations, may result from separate occupational cultures. Resident-nurse conflict resulted from an inability of one group to understand the values, attitudes and needs of the other, and from their relative inexperience, and therefore, insecurity. Simultaneous pressures upon nurses for individuation and standardization were perceived as incompatible when doctors ordered "permissive" treatment for patients who disrupted ward routines. Absence of meaningful communication between doctors and nurses about each other's concerns resulted in perpetuation of incompatible demands upon nurses and consequent frustration and stress.

Objectively staff conflict was not the predominant mode of interaction; subjectively, however, it was defined as an important problem by many personnel. In response to awareness of this problem the Service engaged in continuing discussions and policy-making which led directly to a series of structural changes, each of which it was hoped would resolve the problem.

Attempts to cope with conflict in personality terms were ineffective. Two structural changes -- an administrative resident to mediate between residents and nurses, and a teaching conference for nurses -- also failed to resolve staff conflict. Finally, the creation of doctor-nurse teams, on which a nurse worked exclusively with a resident's patients, effectively reduced conflict.

Through the workings of teams nurses' roles became clarified and communication improved as residents and nurses acquired a larger body of shared meanings. Teams functioned to bridge gaps in understandings and expectations which previously had separated residents and nurses. Explicit in the creation of teams was a changed definition by doctors of the nurses' role from subordinate and of

peripheral therapeutic import to complementary and central to therapeutic concerns. Through the mechanism of teams their derived needs for status-validation and recognition had been met.

After teams had operated for several months it was observed that resident-nurse tension and conflict had noticeably lessened. This change was taken as evidence that the social factors interpreted -- by use of the conceptual framework -- as productive of intra-staff conflict were, in fact, crucially involved. Thus, consequences for staff interaction patterns of these corrective structural changes served as a test of the predictive ability of the conceptual framework.

Microfilm \$2.50; Xerox \$7.60. 162 pages.

#### PERCEPTION OF THE PUBLIC SCHOOL TEACHER'S ROLE AS A CORRELATE OF SOCIAL POSITION

(L. C. Card No. Mic 60-5429)

Lawrence William Drabick, Ph.D.  
The Pennsylvania State University, 1960

To determine the extent to which social position affects the ability of the individual to perceive aspects of his society, nonteacher respondents in Pennsylvania were requested to report the activities in which they believed a teacher to have engaged on the day preceding the interview.

Nonteacher respondents were classified into social categories and the response of category members tested internally as well as against that obtained from other categories.

Response from members of each category was classified into fourteen Teaching Activity Areas. The complete scope of response was considered to be indicative of a composite role model of the teacher and was tested by correlation ranking methods. Great similarity prevailed in all comparisons within and between respondent categories.

The response classifying into each of the activity areas was tested by chi square. Relatively few differences were observed within social categories but numerous differences in response existed between categories.

To test the belief that knowledge of the teacher role would vary with the time of day under consideration, response was divided into the periods of before, during and after school. Most difference was observed in the response for periods outside of formal school hours.

The recorded activities of a sample of public school teachers were obtained as a referant. Response of teachers was tested between types. It was found that the specific position which the teacher held in the educational structure affected the activity patterns reported. This tendency made it impossible to compare nonteacher response with a single teacher role pattern. Rather, the various nonteacher categories were compared with the various teacher types to determine with which there might be the greatest similarity. There was a pronounced tendency for nonteacher response to be most similar to the recorded activities of secondary academic teachers.

The following were among the conclusions reached.

1. Social position was related to the ability of individuals

to perceive the role of the teacher and, by extension, other roles as well.

2. The same elements of the teacher role were perceived by most respondents and the same degree of importance within the role model was assigned to them.

3. The various elements of the role were not perceived with the same intensity by respondents from various social categories.

4. By and large, nonteachers did not perceive the extent to which teachers activated the role elements as part of their role performance.

5. The role of the teacher is affected by nuances of obligation within the over-all status. These are a matter of his position within the educational structure. There is no single teacher role.

6. There is strong evidence that teachers tend to accept the norms of the community and to pattern their role performance in the direction of the expectations held for them by community members.

7. Personnel of the educational colleges are overly optimistic concerning the extent to which teachers internalize the teaching role given them there.

Microfilm \$2.60; Xerox \$9.00. 199 pages.

**SUBREGIONAL MIGRATION, 1935-40:  
AN ANALYSIS OF THE STRUCTURE OF  
MIGRANT CHARACTERISTICS ACROSS  
METROPOLITAN AND NONMETROPOLITAN  
MIGRATION STREAMS.**

(L. C. Card No. Mic 60-3921)

Joseph Randall Godwin, Ph.D.  
University of Illinois, 1960

A basic concern in research on internal migration is the explanation of the incidence of migration. Subregional migration has been studied in terms of migration streams and migration differentials. Principally two methods of analysis have been employed: measurement of rates of migration; and comparing the characteristics of migrants with nonmigrants in order to determine a measure of selectivity. The migration differentials are not so much a reflection of the phenomena of migration, but rather characteristics of the method of analysis. The findings of most studies are manifestations of variations in the methods of measurement and analysis as well as concepts of migration streams and migration differentials.

The possibility that metropolitan and nonmetropolitan subregional migration streams manifest characteristics not yet systematically exposed which may account for the more apparent features of the composition of migration streams was explored in this thesis.

The general hypothesis formulated in this thesis states that (1) an analysis of the characteristics of migrants across metropolitan and nonmetropolitan subregional migration streams would reveal a structuring of migrant characteristics in terms of common factors, and (2) that these common factors are similarly patterned across all migration streams.

The design of the study called for two parts. The first part was the application of factor analysis to the inter-correlations of forty categories descriptive of migrants

within each of four major groups of metropolitan and non-metropolitan subregional migration streams within Illinois for the migration interval 1935-40. The second part was a factor analysis of all subregional migration streams as one group. The latter analysis was utilized to provide a basis for evaluating common factors which would be applicable to all streams.

The results of analyses of four separate groups of migration streams tended to substantiate structuring and patterning of migrant characteristics across migration streams. The factor analysis of all streams made it possible to compute mean factor scores as a criterion for comparison of differences between streams. One general factor was applicable to all streams, however, two additional factors indicated a difference in the structure of migrant characteristics in migration streams between nonmetropolitan areas.

The study casts doubt on the tenability of previous analyses of migration streams and migration differentials. Although the basic classification and tabulation of census data restricted a meaningful interpretation of factors, the findings suggest the major question of whether migration phenomena are a function of the age structure of population aggregates or whether the incidence of migration is a function simply of decisions of persons who do migrate. Factor analysis, as a tool for the analysis of gross data, provides basic insights relating to the nature of the incidence of migration. The conceptual framework of metropolitan and nonmetropolitan migration streams provides a basic analytical model within which probability theory may be employed as a means of describing the expectancies of migration phenomena.

Microfilm \$2.50; Xerox \$7.40. 160 pages.

**SCIENCE AND SOCIAL CHANGE:  
THE EFFECTS OF NEW INSTITUTIONAL  
LOCALS ON THE TRADITIONAL  
STRUCTURE OF SCIENCE.**

(L. C. Card No. Mic 60-5602)

Roger George Krohn, Ph.D.  
University of Minnesota, 1960

In a world that is often described as a world of science, any extensive changes in the discipline are of potential significance to us all. Numerous contemporary students of science--C. Wright Mills, William H. Whyte, J. D. Bernal--to name only a few who have captured the popular mind--have traced changes which they insist are affecting its very creative core. The present study attempts to systematize their observations and subject them to empirical test.

Science originated as a hobby by self-supported and occasionally patronized amateurs pursuing their private curiosity. Its initial success in answering questions about the natural world which had confounded the ancients soon led to its incorporation into the universities. As "natural philosophy" science developed academic traditions of the pursuit of knowledge for its own sake. Rather slowly at first, but more rapidly in the 19th and 20th centuries, science was taken into industry and government, when research by organized teams of specialists was pursued not to implement idle curiosity but to get practical results.



To phrase in a sentence the thesis of recent students: the ability of science to secure practical results is becoming the all dominating motive of contemporary science, tending to replace all other forms.

This study examines the comparative attitudes and values of scientists in the three major institutions which support scientific research, the university, government, and industry. My thesis is that the traditional conception of science as the search for knowledge for its own sake will be best preserved in the university. However, in industry and government there will be a displacement toward a practical conception of science, a professional conception of the scientific role, and bureaucratic conceptions of the organization of research.

To test this thesis empirically the scientific activities in the university, industry, and government in the Twin City area are analyzed. The extent and variety of science in these three institutional areas is described; the social backgrounds, the educational and occupational experiences and the scientific attitudes and values of the scientists employed in them are sketched. Formal tests of the hypothesis of the displacement of the traditional conception of science in the applied institutions were instituted.

The scientists in the applied institutions were indeed found to have a more practical conception of the scientific role, and more bureaucratic preferences in the organization of research. They were also more willing to become administrators and had fewer specifically intellectual aspirations. Further, industry and government were found to be negative to the individualism and intellectualism of the traditional scientific role. There were also accompanying differences in social background, educational and occupational experience, leisure time interests and activities, and in their opinions of the accomplishments and prospects of U.S. science. Thus, the factual basis of the general hypothesis of the recent critics of science is sustained.

The further question of a decline of creativity in Western science raises special problems which could not be taken up in the present study. The most important of these special problems is the definition of creativity itself. However, it does seem clear that industrial and governmental science leads away from basic research. Most students of science agree that it is basic or undirected research that has been the source of the great discoveries in the past. To keep open the possibility for basic research seems to be the major problem in the face of contemporary changes.

Microfilm \$3.60; Xerox \$12.60. 278 pages.

**FROM HOBOHEMIA TO SKID ROW:  
THE CHANGING COMMUNITY OF  
THE HOMELESS MAN.**

(L. C. Card No. Mic 60-5162)

Keith Arthur Lovald, Ph.D.  
University of Minnesota, 1960

The basic thesis of the present study is that the world of the homeless man--the present skid row and its pre-World War II form, hoboemia--represent small encapsulated communities with unique institutions and distinctive

modes of life. It has been our purpose to investigate the ways this community has changed.

Our principal focus is upon the changing life styles of homeless men in which the dynamics of their class, status, and power situations are examined. These three factors constitute the basis for the formation of three classes of social values: wealth, esteem, and social power; in certain kinds of communities these may develop into hierarchies of access. In some instances these value hierarchies fuse in such a way that access to one is dependent upon achievement in the other. When this occurs, a specialized community is the result. Hoboemia and its later form, skid row, are instances of such specialized "status communities."

In 1923, Nels Anderson studied hoboemia. Since that time there have been no major studies of the homeless man and his habitat. Meanwhile the nation's social and economic structure has undergone considerable change, suggesting that the community of the homeless man has changed as well.

In the first part of the study we have sought to examine hoboemia as a status community, as it existed between the two world wars. Our specific interest concerns the community's institutions and the way in which they were related to the hoboemians' economic, social, and political circumstances. The second part reports the findings of an empirical study of skid row. This study was carried out between May, 1958 and November, 1959 in the Gateway district of Minneapolis, Minnesota.

In general, we found many changes. There is little similarity between the contemporary homeless man's class situation and that of his hoboemian predecessor. With respect to occupation, most hoboemians were employed as casual or short-term laborers. A large proportion of these were of the migratory variety. The hobo was a migratory-casual worker. Today there are few hobos making their way by freight train about the country in search of work. Although casual jobs are obtainable in skid row's "slave market," the largest share of the Gateway's population are recipients of some kind of financial assistance, or else they depend upon small retirement incomes.

The homeless man's status situation has improved as he has become less mobile. At different times in hoboemia's history most migratory workers suffered the indignities of threat of arrest for vagrancy. In this sense, the power situation of homeless men has also changed. The hobo could do little to prevent his arrest for vagrancy. His status--easily identified by his manner of dress and his hangouts--often forced him into precarious situations with the police and the courts. Decreased mobility has altered the kinds of situations in which apprehension is likely to occur. As the community of the homeless man has compacted, the forms of social control have also changed. Today, homeless men are more apt to be arrested for drunkenness than for vagrancy.

As might be expected, the community's institutions have also changed. Indeed, the basic hypothesis of the study is that as the homeless man's class, status, and power situations have changed so have his institutions. In general, hoboemia's occupational institutions, of which the slave market was the most important, have been displaced by certain leisure and recreational institutions. Despite these changes, however, skid row maintains strong ties with the past. Microfilm \$6.40; Xerox \$22.75. 502 pages.

A COMPARATIVE ANALYSIS OF  
VERBAL STRUCTURING OF OBJECTS  
AND WORDS BY GROUPS DIFFERING  
IN THEIR HABITUAL ORIENTATIONS

(L. C. Card No. Mic 60-4728)

Sybil Dorothy Speier, Ph.D.  
Clark University, 1960

Supervisor: Bernard Kaplan

This study aims to determine the ways in which individuals, representing divergent orientations towards the world -- in this case, artists and chemists -- verbally give form to the contents of their everyday experience; further, the attempt is made to derive from their modes of structuring the degree of "generality" of the typical addressee towards whom the members of each group implicitly direct their communications.

Starting from the assumptions that, first, structuring operations are, in part, social acts and as such are directed towards communication with others; and, second, that one can, therefore, infer the generality of the typically intended addressee from the kind of structuring operations employed, it was hypothesized that chemists would, in terms of their specialized aims, be directed towards a more generalized addressee, i.e., more distanced and less "intimate," than would artists.

Under instructions aimed at encouraging a wide choice among modes of structuring, 16 art students and 16 chemistry students described a series of 8 concrete objects (e.g., a pair of scissors, a stapler), and stated meanings suggested to them by 8 words (e.g., "scissors," "stapler").

The responses were analyzed in terms of the structuring operations and the orientations they were taken to reflect; the operations and orientations were systematically ordered with respect to the relative addressee-generality implied in their usage. Several analytical indices were employed to measure the dominant types of structuring operations for an individual; these indices were the bases for inferring each subject's typical intended addressee.

The major findings, summarized below, strongly confirmed the general hypothesis:

For object structuring,

- a. Both groups tend to refer to the object directly rather than indirectly, i.e., via the context; chemists, however, exceed artists in the relative incidence of direct descriptions;
- b. In their "direct" descriptions, chemists more typically utilize operations implying a more generalized addressee, viz., naming the object, predicating geometric, quantitative, and physical properties, while artists manifest operations implying a more particularized addressee, viz., predicating physiognomic properties, object-assimilating, and predicating evaluative properties;
- c. In their "indirect," contextual descriptions, chemists give a larger proportion than artists of responses referring to objective contexts rather than expressive of personal reactions;
- d. Where the operation of naming-the-whole is used

at all, chemists tend more frequently than artists to name the object in their initial response;

- e. Chemists are more likely than artists to qualify their articulations of objects by remarks indicating doubt, hesitancy, inference, etc.

For word structuring,

- a. Chemists exceed artists in the degree to which they focus on meaning-aspects of words rather than sign or vehicle aspects;
- b. In their meaning-oriented responses, chemists more typically utilize operations implying a more generalized addressee, viz., classifying, defining, and denoting, while artists manifest operations implying a more particularized addressee, viz., imaging, associating, dynamizing-appraising, and subjective reacting;
- c. In their sign-oriented responses, chemists more typically mention phrases and formulas in which the word is frequently used, e.g., "rock and roll," rather than focussing on sound and shape properties of the word.

These findings were discussed in terms of their implications for the over-all differences between artists and scientists, i.e., in terms of aims underlying their specialized activities; they were also considered in terms of their implications for a theory of cognition which takes into account social contexts of all cognitive activity.

Microfilm \$2.50; Xerox \$5.80. 119 pages.

AN APPLICATION OF THE  
THURSTONE SCALING TECHNIQUE TO AN  
AREA OF SOCIAL WORK PRACTICE

(L. C. Card No. Mic 60-5615)

George Clyde Welton, Ph.D.  
University of Minnesota, 1960

Adviser: John C. Kidneigh

This research project was undertaken to demonstrate the applicability of the Thurstone scaling technique of equal-appearing intervals to an area of social work practice namely, that of a social agency's program of foster care for children. This particular technique of scaling was chosen as it seemed more appropriate to the field of social work than did other already developed scaling techniques. It was believed that this scaling technique held promise for adding to the other self-evaluative measures used by social agencies by having foster mothers act as raters of certain aspects of agency policy and practice relating to the program of foster care for children. Only those aspects of the program were used with which foster mothers could be expected to be acquainted and about which they could or should be asked to make ratings.

Foster mothers were chosen as raters because they would be acquainted with the program of foster care for children in a different way than were the paid social work practitioners of the agency. The foster mothers were both



recipients of service (social workers working with them) as well as observers of service (they could see what the social workers did in their discharge of their professional obligations with the foster children) and the foster mothers were affected by agency policy.

The study was conducted in a private social agency having a program of foster care. Statements of opinion, 197 of them, were judged by 15 randomly selected licensed foster mothers each of whom had had at least one year's experience as a foster mother. The statements were also judged by the 11 social work practitioners of the agency as to where each statement fell on a seven interval favorableness-unfavorableness continuum. The statements were analyzed to derive the S values (scale values which were the medians of the judgments for each set of judges) and the Q values (the interquartile range) as obtained from plotted cumulative ogives. Comparison of the judgments revealed a correlation of  $r_s = .93$  (using the Spearman rank correlation coefficient). This finding was significant at the  $\alpha = .01$  using a t test. This, it was believed, allowed the staff to have confidence that the foster mothers were defining statements much in the same way as were they.

Testing whether or not the two groups of judges made judgments about the statements in a similar manner so that they viewed the same statements as having relatively the same degree of ambiguity was accomplished using Chi-square. This test revealed a lack of association significant at  $\alpha = .05$  level. It was believed that this was accounted for by the fact that the mean Q for social work practitioners was 1.142 as compared to a mean Q of 1.658 for the foster mothers.

Selection of statements for the rating instrument was accomplished by examining the judgments of the foster mothers and eliminating statements with a Q of 1.8 or higher and by choosing statements which gave a range of S values across the favorableness-unfavorableness continuum. Fifty-four statements were selected for the rating instrument.

The rating instrument was mailed to 30 foster mothers. Twenty-two returns were used in the analysis of ratings. The Scale Product method was used which required a Likert-type response to each statement.

Reliability was measured by the split-half technique of comparing responses to the odd- and even-numbered statements. A value of  $R = .84$  was obtained.

It was concluded that this scaling technique can be a useful, reliable device in social work practice and holds promise for wider applicability.

Microfilm \$2.50; Xerox \$7.20. 152 pages.

## SOCIOLOGY, PUBLIC WELFARE

### TYPES OF DELINQUENT GROUPS

(L. C. Card No. Mic 60-5111)

Irving Abraham Spengel, D.S.W.  
Columbia University, 1960

In this exploratory study, anomie theory and opportunity systems theory constituted the framework for the development of a typology of delinquent groups. The conditions of disjunction between aspirations and expectations by young people located in neighborhoods with varying opportunity structures, legitimate and illegitimate, were offered as explanation for the genesis of different types of delinquent subcultures. In the racket subculture, the delinquent group was oriented to participation in limited racket activities and characterized by a pervasive criminal value outlook. In the conflict subculture, the delinquent group was oriented to involvement in a system of gang fighting activities. Here, gang fighting was conceived as the development of an alternate and temporary opportunity system. In the theft subculture, the delinquent group was oriented to participation in a great deal of burglary and car theft activity. Generally, the theoretical formulation and the empirical findings in relation to the theft subculture were of an ad hoc nature.

The racket subculture was conceived as primarily dependent on the existence in the neighborhood of an alternate illegitimate opportunity system. The conflict subculture was regarded as occurring mainly under neighborhood conditions of unavailability of adequate legitimate or illegitimate opportunity systems. The theft subculture was conceived as arising in an area where partial legitimate and illegitimate opportunity structures were present. It was possible to theorize that the racket and theft subcultures constituted routes to different kinds of adult criminal roles. However, the data were insufficient to accept or reject this notion empirically.

The study was both descriptive and analytical. The data were collected through two major procedures: a four month participant-observation process of two types of delinquent groups and one drug addict group; and ninety formal interviews of nine groups of ten subjects each, comprising non-delinquent controls, delinquents and drug addicts from three types of neighborhoods. Data were also obtained through a systematic analysis of the content of conversation of the groups observed and through a more cursory analysis of agency case records and administrative reports.

The findings revealed that delinquents from the racket subculture established very positive and cooperative relationships with racketeers and various neighborhood adults but poor relationships with conventional adults, such as community center workers. The delinquents from the conflict subculture were more oriented to peer associations and were more distant from adult systems of relationship. In general, they had the weakest connections with adults, conventional or criminal. Delinquents from the theft subculture had mainly positive relationships with adults, but tended to have particularly poor relationships with parents, suggesting the more significant operation of a personality factor or an intervening psychological variable in the genesis of this kind of delinquent adaptation.

The responses of the drug addicts were intermediate, falling between those of the non-delinquents and delinquents

in each of the three subcultures. It was reasoned that addiction might be a mechanism of adjustment employed by the former gang member during late adolescence to approach a more normative and a more adult status.

The observational data supported the findings of the interview material and served, in addition, to distinguish characteristic subcultural styles of life in terms of gang traditions, organization and membership patterns, group symbols and rituals, etc. Relevant data were not available for the theft subculture.

Finally, social work intervention in the racket subculture was recommended mainly to assist in the destruction of the illegitimate opportunity structure. Advised also was a massive public program of support for the development of a broad system of equal social and economic opportunities to upgrade the neighborhoods containing the conflict subculture. The most fruitful area for the deployment of primarily social work services was conceived to be the theft subculture.

Microfilm \$4.50; Xerox \$16.00. 352 pages.

## SOCIOLOGY, RACE QUESTION

### REACTIONS TO DESEGREGATION: A STUDY OF NEGRO MOTHERS.

(L. C. Card No. Mic 60-4855)

Dorothy Elizabeth Pitman, Ph.D.  
The University of North Carolina, 1960

Supervisor: Daniel O. Price

This study is concerned with three facets of interracial relations: the perception which the minority group has of itself in contrast with the majority group; the attitudes and feelings expressed by minority community members concerning interracial contact with the majority group; and the patterns of reaction to measures designed to delay or circumvent granting of certain rights to minority group citizens. The study focuses upon desegregation in schools and colleges, churches, voluntary associations, and public transportation.

The sample for the study consisted of 151 Negro mothers, with children of or below school age, representing the rural and urban populations of Alamance County, North Carolina. The data were collected in personal

interviews, each of which was approximately one and one-half hours in length. A sub-sample of the respondents was interviewed by a Negro interviewer.

The data were analyzed according to the age of the respondent, her educational level, family income, place of residence, participation in voluntary associations, and her image of the Negro vis-a-vis the white person. Chi square and mean square contingency coefficients were used to determine association between responses and these variables.

The findings of this study support the assumption that there has developed, within the Negro community, a new image of the Negro that allows him to perceive himself as equal to the whites, or capable of being equal given opportunity for training and for obtaining positions for which he is qualified. Those who perceive the Negro as inferior to whites do not differ significantly from other mothers in the Negro community; their perception might be explained in terms of their differential experiences with white persons and their basic personality structure.

The feelings of probable reactions to desegregating situations vary according to one's educational and income levels; those of higher levels tend to prefer interracial activity in schools, churches, and voluntary associations more often than do those of intermediate or lower levels. The general attitude toward desegregation in schools was expressed as one of fear of mistreatment of the Negro child, with preference expressed for segregated schools that are comparable in equipment and standards with the white schools. Militant reactions toward proposals to circumvent desegregation were characteristic of the younger, more highly educated mothers whose family incomes are above the average in the Negro community. However, a hesitancy to be the first to enroll their children in formerly all-white schools was expressed by those mothers whose educational level was above that of high school graduate and who felt that the psychological impact upon the Negro child would be detrimental to his academic development.

Sentiment in the minority community on social issues was not found to be unanimous; marked differences were found between those having lived only in the Southeast and those having lived in other regions. Rural-urban differences in sentiment were not found to be statistically significant.

The study emphasizes some problems that are encountered in eliciting information in the Negro community. Differences in responses to Negro and white interviewers were analyzed. Negroes more often expressed feelings of limited opportunity to the white interviewer, with feelings of Negro superiority to white persons and favorable reactions to desegregation more often expressed to the Negro interviewer. Microfilm \$3.15; Xerox \$11.05. 241 pages.



## SPEECH-THEATER

### A RHETORICAL ANALYSIS OF THE AMERICAN PRESENTATIONAL SOCIAL THEATRE OF THE THIRTIES

(L. C. Card No. Mic 60-5590)

Bertram Barer, Ph.D.  
University of Minnesota, 1960

The purpose of this thesis is to investigate the persuasive techniques of the American presentational social theatre of the thirties. It is the contention of this thesis that American social dramatists employed, within a presentational framework, platform methods that heightened the rhetorical impact of their plays. This dissertation submits that these persuasive devices can be isolated, described and analyzed.

Chapter I introduces the experimental temper of the anti-illusional social theatre of the United States. Brief parallels are drawn between this native endeavor and the European propaganda theatre after World War I.

Chapters II through V provide an analysis of eight representative dramas of public address. The plays are grouped into chapters according to the social issues they reflect.

Chapter II, entitled "Attacking Business Materialism," contains Processional (1925) by John Howard Lawson (a forerunner to the works of the thirties) and The Cradle Will Rock (1937) by Marc Blitzstein.

Chapter III, "Championing Labor," presents Waiting for Lefty (1935) by Clifford Odets and Pins and Needles (1937) by the ILGWU.

Chapter IV, "Supporting Government Action," offers Power (1937) and One-Third of a Nation (1932) by Arthur Arent.

Chapter V, "Attacking the Evils of War," presents Johnny Johnson (1936) by Paul Green and Bury the Dead (1936) by Irwin Shaw.

Each drama is investigated to find the ways in which persuasive techniques are manifested in sets, plot structure, action, character, and dialogue.

Scenery in each production is employed to enhance the persuasion of the dramatist. The vaudeville drops of Lawson and the ILGWU are designed to mock the false materialist values of the nation. Minimal scenery in the works of Odets and Blitzstein informs the audience that times are poor and that the performance deals with fundamental problems of survival in the depression.

Episodes of the plot structures serve as arguments by example in support of the author's contentions. The cumulative effect of each scene adds to the rhetoric of the play.

In dramatic action, those activities which hail proletarianism are moral movements; a character's effort to oppose this trend is immoral. In addition, parades are devised to portray the characters' adherence to an ideal. Voice votes relate the personages' hailing of social revolution. Lines of argument -- argument by comparison, analogy, and definition -- are utilized to make the propositions more meaningful to the spectators.

Dramatic figures are drawn more as rhetorical instruments than as complex, individualized people. Some appear as cartoon stereotypes and others are imitations of actual people. Many actors pose as orators as they speak directly to the audience.

The heroes are proletarians; the villains are capitalists. A harbinger of social change appears in some productions to lead the disinherited masses to victory. In Processional, a character who may be called a master of the capitalist status quo appears. However, such a leader does not appear in the dramas of the thirties, which indicates the aimlessness of the supporters of private profit.

The propaganda playwrights capture the turmoil of the decade in their rhythmic, terse lines. Blitzstein, the ILGWU, and Arent utilize song lyrics to intensify the emotional impact of the persuasion. Arent and Green use orchestral scores which are designed to comment on the dramatic action.

Chapter VI presents a summary and conclusion. This is followed by a bibliography and appendices which offer a social and political survey of the thirties and a history of the social theatre in that period.

Experiments of propaganda playwrights with platform methods reflect the experimental temper of the decade. Social dramatists sought new presentational forms to express their new ideas.

Microfilm \$3.75; Xerox \$13.05. 289 pages.

### THE PUBLIC SPEAKING OF PAUL V. McNUTT

(L. C. Card No. Mic 60-4153)

Steven Merriman Buck, Ph.D.  
Purdue University, 1960

Major Professor: N. B. Beck

This study investigated and evaluated the public speaking of Paul V. McNutt, former governor of Indiana and long-time federal official. Specifically these questions were posed: (1) What types of speaking did McNutt do? (2) What kind of speech training did he receive? (3) What were his theories of rhetoric and speaking? (4) What method of speech preparation did he use? (5) What major ideas predominated in his speaking? (6) What kinds of arguments and evidence did he use and how valid were they? (7) What were the characteristics of his oral style? (8) How did he adapt to conditions, times, and audiences? (9) What were the immediate, intermediate, and long-range effects of his speaking?

McNutt gave more than a thousand political, policy making, informative, patriotic, and ceremonial speeches from 1925 through 1950.

Paul McNutt had no formal training in public address.

He had extensive dramatic experience in college and received additional training by participating in student government. McNutt participated in the "Moot Court" at Harvard Law School.

No statement of his theories of public address was found. The frequency of his speaking and his careful preparation indicate that he ranked public speaking high as a tool of government, an aid to his personal career, and as a source of income.

McNutt used two methods of speech preparation. He either wrote the speech out in longhand or dictated it to a stenographer.

McNutt's major ideas included belief in the "American way," appreciation of the soldier's sacrifice, continued military preparedness, strong support for public education, liberalized taxation, relief for the unemployed and handicapped, the greatness of the state of Indiana, and the importance of returning the government to the people. During World War II, McNutt's major theme was winning the war through whatever sacrifices were necessary. His last major theme was conservative internationalism, with overtones of American paternalism and imperialism.

Ten speeches by Paul V. McNutt were analyzed in detail. Typical speeches were chosen on the basis of their importance to Paul V. McNutt's career and their textual reliability.

McNutt used a didactic development in nine of the ten speeches analyzed. He frequently relied on illustration as evidence in his early addresses. In later speeches, he used more statistics and testimony. Deduction was his most frequent logical device, but he relied more on motive appeals than on logical reasoning. Within their contexts, his arguments appear valid.

McNutt's style, in his early speeches, was elaborate. His final speeches were simple and balanced. McNutt's delivery was a mixture of great physical intensity and little overt bodily activity. He used few gestures. He moved little on the platform because of the presence of a fixed public address microphone and the fact that he relied heavily on a script in his speeches. McNutt had a mobile face and used head and shoulder gestures effectively.

McNutt adapted well to his audiences, usually making topical references in his speeches. He apparently recognized that at times he was speaking both to the immediate audience and to an unseen audience. Available attitude measurement data showed McNutt's speech content nearly always conformed with the major attitudes and rarely ran counter to them.

McNutt had great immediate success as a speaker, but was less effective in influencing events over a long period of time. McNutt's chief weakness was a tendency to be noncommittal on major policy in order to remain politically acceptable. In the final analysis, McNutt must be termed an effective speaker, but not a great orator.

Microfilm \$2.50; Xerox \$8.60. 188 pages.

# AN ANALYSIS OF CONTEMPORARY SPEECH EDUCATION IN AMERICAN PROTESTANT SEMINARIES

(L. C. Card No. Mic 60-6098)

William Keith Clark, Ph.D.  
Purdue University, 1960

Major Professor: Dr. W. Charles Redding

The purpose of this study was to investigate the extent to which certain accepted "postulates" of contemporary speech education govern the philosophy underlying the teaching of speech and homiletics today in American Protestant theological seminaries.

The following procedures were used:

1. A survey was made of curricular offerings and requirements, as described in catalogs, in speech and homiletics in all the fully accredited (and several partially accredited) American Protestant seminaries (total: 80).
2. A questionnaire was devised, dealing with opinions concerning the need for speech training for ministerial students and the place of speech offerings in the seminaries. This questionnaire was completed by seven of the eight directors of higher education for the largest Protestant denominations.
3. Another questionnaire, dealing with opinions concerning the place of certain speech courses in seminary curricula, was completed by six of nine members of the Accrediting Commission for the American Association of Theological Seminaries.
4. A third questionnaire, dealing with attitudes toward speech training for ministerial students and the place of certain speech courses in seminary curricula, was completed by eight prominent practicing preachers.
5. Representative contemporary textbooks in rhetoric-persuasion and in homiletics were analyzed for "basic postulates" of rhetorical or persuasion theory and of homiletics theory.
6. An opinion questionnaire, derived from these postulates of speech and homiletics, was constructed and completed by 160 (of 223) teachers of speech and/or homiletics in 76 of the 80 seminaries, and by 12 (of 14) selected experts (textbook writers, etc.) in secular speech education.
7. Seven authorities in preaching and/or seminary speech education were personally interviewed.

Descriptive, rather than sampling, statistical analysis was appropriate for most of the data, especially since the central core of the inquiry dealt with non-quantifiable nuances of philosophy, and since this group of respondents resisted giving univocal, quantifiable replies.

Among the most important conclusions were the following:

1. Both in attitude toward speech "in general" and specific recommendations (or requirements) of speech for potential ministers, verbal approval was given by church officials occupying influential positions.
2. Actual seminary regulations, however, did not reflect this highly favorable attitude to the same degree as the opinion data would have led one to expect.
3. The "congruence" concept of persuasion was neither accepted nor rejected by many of the seminary teachers; most were not familiar with the concept.
4. A concept of persuasion, interpretable as unethical or nonethical, was accepted by only a very small proportion of the seminaries.



5. The "logic-emotion" dichotomy was rejected by a large majority (81%) of the seminarians; but it was accepted by 19% of them.

6. The "persuasion-conviction" dichotomy was rejected by 61% of the seminarians and accepted by 21% of them.

7. Both dichotomies were accepted by 13% of the seminarians; none of the secular speech experts accepted both of them.

8. A "faculty psychology" approach to preaching was accepted by 86% of the seminarians; only 5% of them definitely rejected it.

9. The basic postulates of secular "speech composition" were accepted by 78% of the seminarians; only 2% rejected them.

10. An "audience-oriented" approach to the speech situation was specifically accepted by fewer than 40% of the seminarians, but only 3% explicitly rejected such an approach.

11. The audience-oriented approach to seminary speech pedagogy was accepted by 24% of the seminarians; it was rejected by only 6% of them.

12. Most of the seminarians were apparently not far out of step with the sampled secular speech experts in their attitudes toward the logic-emotion and persuasion-conviction dichotomies, the basic postulates of "speech composition," the "congruence" concept of persuasion, and definitions of persuasion involving ethics; however, as many as one-fifth of the seminarians accepted either or both of the dichotomies, while none of the secular speech experts did so.

13. The seminarians were far out of step with the sampled secular speech experts in their attitudes toward "faculty psychology" and "audience consciousness," as basic concepts in the theory and practice of preaching.

14. Most of the seminary teachers apparently rejected in theory an audience-oriented approach to preaching, while in actual practice utilizing such an approach when dealing with the details of preparing and composing the sermon. Microfilm \$5.35; Xerox \$18.90. 419 pages.

#### THE EFFECTS OF SIDE-TONE FILTERING ON CERTAIN SPEECH CHARACTERISTICS OF STUTTERERS

(L. C. Card No. Mic 60-6101)

Warren Scott Curtis, Ph.D.  
Purdue University, 1960

Major Professor: M. D. Steer

The effects of 800 cycle per second high-pass side-tone filtering on the fluency, word rate and phonation/time ratio of ten college-age stutterers were investigated. Speech samples were recorded under six experimental conditions: (1) unaltered side-tone; (2) 800 cycle per second high-pass side-tone frequency filter, laboratory type; (3) binaural hearing aids modified to approximate an 800 cycle per second high-pass side-tone frequency filter; (4) standard binaural hearing aids; (5) inoperative binaural hearing aids; and (6) a head bandage which altered appearance but not audition. Speech samples were

recorded under the above conditions in the following situations: (a) five consecutive readings of the same passage to one listener; (b) one reading of the passage to one listener, one telephone listener and five listeners; and (c) a partially structured spontaneous speech to one listener.

Effects of conditions and situations were tested by application of analysis of variance technique with the following results: (1) fluency, words per minute rate and phonation/time ratios for the group were all increased from a control sample under each experimental side-tone condition in each speech situation tested. Such increases were not in most instances statistically significant; (2) among subject differences were statistically significant at the one percent level in all analyses performed; (3) speech alterations observed were of the same magnitude and in the same direction for all side-tone conditions tested; (4) statistically significant findings occurred at the five percent level as follows: stuttering blocks, interaction of readings and subjects and interaction of conditions and subjects; words per minute, differences among situations and interaction of situations and conditions; phonation/time ratio, differences among conditions.

Conclusions of the study were stated as follows: (1) Decreased non-fluencies and increased words per minute rate and phonation/time ratios can be observed in speech samples of stutterers when such samples are taken while the airborne side-tone of the speakers is being delivered through an 800 cycle per second high-pass frequency filter system. The speech alterations observed are variable from subject to subject and are, for groups, too small to be attributed to factors other than chance; (2) Speech alterations observed are not appreciably different if the side-tone is delivered by a laboratory filter system, standard binaural hearing aids, or binaural hearing aids modified to approximate an 800 cycle per second high-pass laboratory filter system; (3) Speech alterations similar to those for side-tone filtering can be obtained through the use of inoperative binaural hearing aids or the wearing of a head bandage.

Microfilm \$2.50; Xerox \$7.80. 166 pages.

#### A STUDY OF CHARACTERIZATION IN SELECTED DISQUISITORY PLAYS OF BERNARD SHAW

(L. C. Card No. Mic 60-5657)

Charles Richard Gillespie, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor O. G. Brockett

Many conflicting opinions have been expressed concerning Shaw's ability to create recognizable and individual characters in his plays. The controversy is particularly acute regarding his later discussion plays. This study examines the product and methods of Shaw's characterization in his "disquisitory" plays.

Shaw applied the description "disquisitory" to only one play, *Getting Married*. Critics have applied the term to two other plays, *Misalliance* and *Heartbreak House*, both written within a decade of *Getting Married*. An

examination of these three plays reveals the following similarities. They are organized around a discussion of one or more central themes, and they have no single predominant character or story, but rather have a number of characters involved in several stories all related to the central themes. When all of Shaw's plays are examined in light of these criteria, a total of twelve are discovered which fit the definition of "disquisitory." Six plays, providing a representative cross-section chronologically, thematically and qualitatively of Shaw's "disquisitory" plays, are analysed in this study. The plays chosen are: Don Juan in Hell, Shaw's first attempt to write a completely rhetorical play; Getting Married, the play in which he first introduced the word "disquisitory"; Misalliance and Heartbreak House, the plays in which he brings the form to its highest expression; and Geneva and In Good King Charles's Golden Days, two examples from Shaw's final works.

Résumés of the story and argument of each play, and analyses of each of the sixty-two characters in the "disquisitory" plays appear in the appendixes of the dissertation. In the body of the study are analyses of Shaw's methods of revealing character, his use of character to present his argument, and his patterns of characterization.

Some of the outstanding techniques Shaw employs to reveal character are special scenes in preparation for the entrances of certain key characters, scenes of conflict especially designed to reveal character immediately upon the initial entrance of the character, and scenes based upon the opera structure of duets, trios, choruses, etc., designed to shift focus among characters and plot complications throughout the plays. Shaw shows his greatest ingenuity and imagination in revealing character in Getting Married, Misalliance and Heartbreak House, and his greatest weaknesses in Geneva.

Shaw uses his characters three ways to present his arguments in the plays. He has them express ideas, illustrate points of view by their actions or backgrounds, and appear relatively sensible or comic. Although the different characters vary in their relative importance in presenting the arguments, they can all be classified as either supporting Shaw's own position, attacking it, alternately supporting and attacking it, or being neutral toward the major issues of the play. Shaw develops his techniques of using his characters to support his arguments in greater complexity from Don Juan in Hell to Heartbreak House. Geneva and Good King Charles represent retrogressive steps in his technique.

Shaw's patterns of characterization are analysed according to complexity, depth, consistency, completeness and repetition. His chief strengths are in complexity and depth of characterization, and his chief weaknesses are in consistency and completeness. He is sometimes repetitious in the character types he employs.

In the "disquisitory" plays Shaw reveals an ability to build upon a strong sense of character type, and is able to characterize quickly and vividly. He shows a good imagination for creating dramaturgical techniques appropriate to his unusual dramatic form. His chief weaknesses are occasionally settling for too narrow a stereotype, over-exaggerating for comic effect, over-intellectualizing his characters, and using characters uneconomically. In the individual plays, he has his greatest success with characterization in Misalliance and Heartbreak House, and his least success in Geneva.

Microfilm \$3.95; Xerox \$13.95. 307 pages.

A CONTENT ANALYSIS OF THE  
1959-1960 COMMUNICATION TRAINING  
PROGRAM OF THE PURDUE UNIVERSITY  
COOPERATIVE EXTENSION SERVICES  
WITH EMPHASIS ON CERTAIN  
COMMUNICATION PRINCIPLES

(L. C. Card No. Mic 60-6115)

James Albert Johnson, Ph.D.  
Purdue University, 1960

Major Professor: Henry L. Ewbank, Jr.

The investigation, using the methods of content analysis, analyzed the complete oral output of 11 inservice training communication workshops sponsored by the Purdue University Agricultural Extension Service and presented during the school year, 1959-60. Workshops analyzed included one each of the following types: Basic Communication, Public Speaking-Group Discussion, Interview, Radio, and Photojournalism. Also included in the study were two Photography, two Visuals, and two Written Workshops.

The purposes of the investigation were threefold:

1. A description of the communication workshops in order to promote a clear and coordinated view of the total training program.
2. A test of the method of content analysis in a new situation in order to determine its suitability as a means of measuring the extent to which certain principles are emphasized in this situation.
3. An analysis of the oral content of the workshop sessions to reveal which of certain stated communication principles, if any, were stressed and to what extent, in order to promote the effective development of future training programs of the Cooperative Extension Service both at Purdue University and elsewhere.

Each workshop program was recorded on plastic tape and played back for purposes of analysis. Ten principles recognized to be of basic importance to effective communication were derived from a series of interviews and from an analysis of 25 works on rhetoric and photography. The communication principles identified were Purpose, Adaptation, Knowledge, Clearness, Organization, Movement, Simplicity, Originality, Brevity, and Humor.

These precepts were the content categories against which the oral content of each workshop was measured in order to determine the degree (if any) to which these principles were taught in Instructor Lectures, Student Assignments, and Evaluation sessions.

Reliability of the content analysis was checked in two ways: (1) consistency among analysts; and (2) consistency through time. In addition to the investigator six coders analyzed segments of oral content selected at random from five types of workshops. Because the coders had not been exposed to the visual stimuli that were presented in those workshops that emphasized the visual channel of communication, these programs were not included in the reliability check sessions.

The extent of agreement among analysts and coders was 84.7 per cent which was interpreted as indicating adequate consistency among analysts.

The second reliability check was carried out by the investigator by recoding segments of oral content selected at random from each type of workshop after a time lapse of approximately one month. The extent of agreement between the first and second analyses was



95 per cent which was interpreted as adequate consistency through time.

The results of the investigation appeared to warrant the following conclusions:

1. The method of content analysis is practical and useful in determining the presence and amount of consideration given to certain defined communication principles.

2. Each of the 11 communication workshops analyzed devoted some part of its complete oral content to a consideration of several of the specified communication principles.

3. In each workshop some of the ten communication principles were emphasized to a greater degree than were certain other of these precepts.

a. In those workshops that were based on the oral channel of communication, the principles of Adaptation and Organization comprised 77 per cent of the complete oral content that was devoted to the particular communication concepts. In addition, the precepts of Adaptation and Organization comprised 38 per cent of the complete oral content of these workshops.

b. In the workshops that stressed the visual channel of communication, the principles of Organization and Adaptation comprised 78 per cent of the complete oral content devoted to the specific communication precepts. Thirty-nine per cent of the complete oral content of these workshops treated in one way or another these two principles.

c. In the workshops that were based on the written channel of communication, the precepts of Clearness and Adaptation constituted 49 per cent of the complete oral content given to the particular communication principles. In addition, these two precepts comprised 35 per cent of the complete oral content of these workshops.

4. Humor as a principle of communication was not treated in the oral content of any of the workshop programs. Microfilm \$3.90; Xerox \$13.75. 304 pages.

#### ARTICULATION TEST MEASURES AND LISTENER RATINGS OF ARTICULATION DEFECTIVENESS

(L. C. Card No. Mic 60-5668)

Evan Paul Jordan, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor Dorothy Sherman

The purpose of this study was to evaluate relationships between measures obtained primarily from the phonetic analysis of articulation test responses and measures of defectiveness of articulation obtained from listener ratings of short samples of connected speech.

The measures obtained from analysis of the articulation test responses concern the following factors: number of speech sounds defective; frequency of occurrence in the language of the sounds misarticulated; phonetic consistency of the speech-sound errors; type of sound-error (omission, substitution and distortion); position of the consonant sounds misarticulated; function of the misarticulated consonant sounds; phonetic category of sound misarticulated; sounds misarticulated in blends. One

additional factor, not obtainable from articulation test data, was also included. This factor was the age of each child as estimated by observers listening to his running speech.

A group of 36 listeners scaled 150 30-second tape-recorded samples of the running speech of children with respect to the severity of the articulation defect exhibited by each child. This measure became the dependent variable in a multiple regression analysis. The 23 independent variables in the analysis were 22 measures obtained from children's articulation test responses and the estimated age measure. On the basis of the results of the regression analysis and from the relationships revealed in the associated intercorrelation matrix, the following conclusions seem justified:

1. Articulation test responses can provide valid samples of the articulatory behavior of children in running speech.
2. The reactions of the listeners quantifying severity of articulation defectiveness seem primarily dependent upon three factors: the frequency with which articulatory deviations occur in the child's speech, the degree of articulatory deviations exhibited by the child, and the estimate of the child's age.
3. In terms of the reactions of listeners, in general, omissions are a more deviant form of misarticulation than substitutions and substitutions are more deviant than distortions.
4. The best single indication to be obtained from articulation test responses of the deviancy of the child's articulation in continuous speech is the count of misarticulated single consonants.

Microfilm \$2.50; Xerox \$6.00. 122 pages.

#### AN X-RAY STUDY OF UNREPAIRED, INCOMPLETE CLEFT PALATE ORAL-PHARYNGEAL STRUCTURES AND THEIR FUNCTIONING DURING VOWEL PHONATION.

(L. C. Card No. Mic 60-5137)

Joseph Sessions Keenan, Ph.D.  
The University of Florida, 1960

A study team of dentists and a speech pathologist, sponsored by the United States Department of Health, Education, and Welfare, visited the island of Puerto Rico in June, 1957 and June, 1958. Their purpose was to gather data on individuals with unrepaired cleft palates. They made available to the writer for analysis X-ray plates and tape recordings of the adult subjects with incomplete, unrepaired cleft palates. The purpose of the present study was to determine the structural and functional effects of this unrepaired anomaly after maturation. More specifically, answers to the following questions were sought: (1) How does the incomplete, unrepaired cleft palate group compare to a normally structured group of the same national origin in structural and functional measurements? (2) How does this cleft palate group compare to a similar

group with complete, unrepaired cleft palates? (3) How does this cleft palate group compare to certain groups of other cleft palate subjects who had received early surgical repair? (4) How does the presence of this unrepaired anomaly affect speech?

The experimental group was composed of twenty Puerto Rican adults with incomplete, unrepaired cleft palates. Antero-posterior and lateral head X-rays were taken of each experimental subject, showing him at physiologic rest and during the phonation of three vowels. These X-rays were traced and measurements were taken from the tracings. The control group, twenty normally structured adults, all exhibited normal Puerto Rican speech and hearing. Similar X-ray plates were made of this group, and the plates were similarly traced and measured. The measurements made on both groups included oral and pharyngeal structures, openings, and movement from rest to phonation positions. The measurements were statistically analyzed. Tape recordings were secured for members of both groups, and were rated for phonetic accuracy and deviations from normal oronasal resonance. Correlations were made between the physiological and the acoustical measurements.

The analysis of the physiological measurements revealed more similarities than differences between the experimental and control groups. Most prominent among the experimental subjects were larger velo-pharyngeal openings and wider maxillae and mandibles. These appear to be directly related to the unrepaired cleft condition. Other differences appeared with less consistency, and may or may not be directly related to the unrepaired cleft. They include variability in tongue positions and differences in mouth opening.

Almost no physiological differences were found between the present experimental group and a similar group with complete, unrepaired cleft palates. Whereas many individuals with early surgical repair have been shown to suffer retarded facial growth, the present experimental subjects were somewhat wider in jaw width, but in general nearer to normal.

Analysis of the acoustical measurements revealed a wider range of phonetic inaccuracies. Some inconsistencies were noted, indicating the presence of a functional disorder complicating the organic disorder, but for the most part the present experimental group tended to misarticulate the same sounds as did the group with complete, unrepaired cleft palates. Voice quality among the experimental group was markedly different. Most of these subjects were judged to have seriously deviant oronasal resonance.

Correlation of physiological and acoustical measurements indicated that more phonetic errors were consonant with greater maxilla width. Also, more deviant voice quality was consonant with the tongue held lower and further back on one vowel, [i].

Disagreements have long existed in the field of cleft palate management. Evidence has been published both supporting and condemning early surgical repair. From a structural point of view, the present study would seem to offer strong support for delaying any procedures which might retard facial development until near normal growth had been achieved.

Microfilm \$2.50; Xerox \$5.80. 116 pages.

ELITCH'S GARDENS, DENVER, COLORADO:  
A HISTORY OF THE OLDEST SUMMER  
THEATRE IN THE UNITED STATES (1890-1941).

(L. C. Card No. Mic 60-5831)

Edwin Lewis Levy, Ph.D.  
Columbia University, 1960

Chairman: Paul Kozelka

The purpose of this study was to trace the development of the theatre at Elitch's Gardens in Denver, Colorado, from its beginnings in 1890 through its fiftieth anniversary in 1941. Within the six areas of management, directors, plays, actors, audiences, and facilities, the writer has analyzed the chronological development of the theatre, as well as its relationship to the city of Denver and to the American theatre.

As early as 1881, Denver was a "good" theatre town; from the heyday of the road show until its final decline, the city was on the itinerary of every important traveling company that played in the West. Before 1890, however, there were few opportunities for Denver citizens to continue their theatre-going during the summer months. Furthermore, the city lacked adequate recreational facilities. Therefore, when John and Mary Elitch established their resort in May, 1890, they fulfilled an important theatrical, as well as recreational, need in Denver.

Elitch's provided rare experiences: as the only "Independent" theatre operating in Denver during the monopolistic days of the New York Theatrical Syndicate, it presented many distinguished actors who, otherwise, would not have been allowed to perform in the city. Furthermore, it introduced to Denver many promising young actors who later achieved renown in the New York theatre, as well as in other media of entertainment.

Since its inception, Elitch's has reflected the theatre of the United States in general and New York in particular. During the first era of its operation, the management presented a wide variety of attractions--minstrel shows, vaudeville, musical comedies, operettas, and motion pictures--all of which maintained a certain popularity in New York through the 1890's and the turn of the century. By 1896, however, it was apparent that the most successful and popular policy for the gardens was the resident stock company plan, a policy not only continued by managers who succeeded the founders but also adopted by operators of other summer theatres throughout the United States.

Although Denver managers were basically dependent upon the New York theatre for dramatic fare, Elitch directors often produced new scripts, thereby adding variety to a season's program and attracting national attention to Denver before the "summer showcase" became a popular, inexpensive means of trying out new plays. Moreover, playgoers who attended the gardens regularly between 1920 and 1941 gained a liberal experience in the developing American drama of this period; Elitch companies performed works of outstanding native playwrights very soon after their New York premières.

Further reflecting national theatrical trends, acting and directing styles at the gardens--basically realistic--adhered to the qualities popular in the New York theatre at the same time. As the characteristics which comprised the style of realism altered, players at Elitch's adjusted their techniques accordingly.



The uniqueness of Elitch's Gardens is substantiated by at least five important accomplishments: (1) its record of longevity, unequaled by any other summer theatre today; (2) the independence of local ownership and management, relating it more closely to the community than is usually possible; (3) the basic management policy of providing "wholesome, family-type" entertainment; (4) the impressive tradition of the many great actors of the past who have performed there; and (5) the presentation of challenging and stimulating classical plays, as well as that of original scripts.

Sociologically, Elitch's Gardens reflects the changing economic conditions, social attitudes, and cultural tastes of people who were permanently establishing themselves in a city which had passed from the frontier stage to that of a modern metropolis. Historically, it is a local manifestation of important theatrical trends which were national in their scope.

Microfilm \$6.15; Xerox \$21.85. 484 pages.

**COSTUMING ON THE NEW YORK STAGE  
FROM 1895 TO 1915 WITH PARTICULAR  
EMPHASIS ON CHARLES FROHMAN'S COMPANIES**

(L. C. Card No. Mic 60-5677)

Janet Loring, Ph.D.  
State University of Iowa, 1960

Chairman: Assistant Professor Margaret S. Hall  
Co-Chairman: Associate Professor William R. Reardon

The purpose of this study has been two-fold: to add to the knowledge of the general history of costuming and the American theatre by defining the significant role that costuming played on the Broadway stage, particularly in Charles Frohman's New York companies from 1895 to 1915; and to present a compilation of original material pertaining to the costuming of the era. The manuscripts and pictures include among other illustrations: a correspondence between Charles Frohman and Alf Hayman about costuming, a complete wardrobe inventory made for Liebler and Company in 1908, bills of sale for costumes, wardrobe plots, and estimates of costumes submitted by costumers to producers.

Charles Frohman's New York companies have been made the focal point of the study for three reasons: Frohman was the major producing member of the powerful Theatrical Syndicate operating during these years. His costuming set the pace for the era until the advent of the art theatre movement. Most of the original material about costuming pertained to his companies. The attitudes, procedures, and criticisms of his costuming have been recorded and compared with the practices of others according to the basic progression of putting a costume on the stage. Each chapter, save the last, represents a different step in the development of the costume from the producer, to the director, to the star, to the source, to the stage, and to the critic.

The final chapter presents a summary of the findings of the dissertation. Of the more general conclusions, two are of particular importance: The profound appeal costume had as an attraction to the audience; and the

significant effect this in turn had on the writing of plays, the selection of plays to be produced, the hiring of performers, and the cost of production.

Frohman may be considered a pioneer in costuming society dramas and musical comedies because he was sufficiently astute to realize that there were two commodities which audiences craved--stars and clothes, and that the actress and the fashionable wardrobe she had to furnish could be improved through a division which would permit him to control each separately.

To insure this command, Frohman further broke with existing practices by extending his power over costuming in various ways: He controlled the quantity and type of costume through the selection of plays. He controlled the effect of costume by engaging and instructing sympathetic personnel to aid him in accomplishing his goals, by financing all costumes save some modern dress for men and non-spectacular gowns for minor parts in dramas, and by providing for at least two dress rehearsals with a dress parade.

Largely as a result of these practices, stars were eager to play under Frohman's management and audiences were guaranteed the latest styles with star attractions. It was Frohman's formula of frills, a formula which greatly influenced the production practices of the major New York companies from 1895 to 1915.

Microfilm \$5.75; Xerox \$20.30. 449 pages.

**COMMUNICATION SKILLS OF CHILDREN  
WITH CLEFT LIPS AND PALATES**

(L. C. Card No. Mic 60-5684)

Hughlett L. Morris, Ph.D.  
State University of Iowa, 1960

Co-Chairmen: Professor D. C. Spriestersbach  
Associate Professor Frederic L. Darley

The performances of 102 children with cleft palates on 17 language and non-language variables were analyzed and compared with appropriate norms to determine the extent of possible retardation. Interrelationships among the variables for each cleft-type group and for cleft-type-groups combined were assessed using an intercorrelation technique.

The sample was restricted to children, singletons of the Caucasian race, between the ages of two years, six months and 16 years, who had essentially normal hearing and no gross evidence of motor involvement. An additional restriction was that all subjects had to perform successfully on at least one language measure.

Fifty responses of connected speech were recorded in longhand for each child. The speech samples were analyzed for mean length of response, variability of response length, structural complexity, index of spontaneity, and number-of-different-words. The Templin Diagnostic Articulation Test and scale values derived from ratings of defectiveness of articulation in connected speech were employed as indices of articulation skill. The Ammons Full-Range Picture Vocabulary Test, Form A, and the WISC Vocabulary subtest were used to assess vocabulary size.

In addition, the Wechsler Intelligence Scale for Children and the Vineland Social Maturity Scale were administered; ratings of social adequacy were obtained.

The following conclusions appear warranted:

1. There are no significant differences in abilities in communication skill between children with cleft lips and palates and children with cleft palates only.
2. Where direct comparisons with appropriate norms are possible, children with cleft palates are found to be significantly retarded in verbal output, structural complexity, spontaneity, vocabulary size, and articulation skill. They are also significantly more variable in response length.
3. Although the mean intelligence scores for the cleft palate sample are significantly lower than those reported for the norm groups, the mean scores for the cleft palate sample, Templin's sample, and Wechsler's sample were all within the range of average and bright normal intelligence. The magnitude of the intercorrelations between the intelligence and language measures is not sufficiently great to support the contention that differences in learning ability alone account for the extent of retardation found in the cleft palate group.
4. Significant intercorrelations are demonstrated among the measures of communication skill, but the strength of the relationships does not indicate that a single measure may be used as an index of general status of language development.
5. The retardation in communication skill of the children with cleft palates is apparently general in nature and not specifically related to proficiency in articulation skill.
6. In general, the findings of this study support the contention that the consequences of a cleft lip and palate are much more than an anatomical defect. Ideally habilitation programs should include techniques for evaluating other aspects of possible deficit, such as language development, and should be prepared to provide relevant therapy which extends beyond the realm of physical restoration.

Microfilm \$2.50; Xerox \$5.20. 102 pages.

#### A STUDY OF STUTTERING AND THE EFFECTS OF DELAYED AUDITORY FEEDBACK

(L. C. Card No. Mic 60-5686)

James Nathan Neelley, Ph.D.  
State University of Iowa, 1960

Chairman: Professor Wendell Johnson

Twenty-three adult stutterers and 23 adult non-stutterers read a 100-word passage five times under normal auditory feedback (NAF). Twenty-four hours later all subjects read the same passage five times under delayed auditory feedback (DAF). The delay time was 0.14 second.

The speech behavior of the two groups under DAF was studied with reference to the omission, substitution, and addition of sounds, and correct word rate (CWR) in seconds. There were no significant differences between the groups with reference to the combined errors and with reference to CWR.

Samples of speech produced under DAF were rated on a nine-point scale of "speech disturbance." The mean rating for the stuttering group was 4.00 and the mean rating for the non-stuttering group was 3.70. The difference between the means was not significant at the five per cent level, suggesting that the "speech disturbance" was perceived by the listeners to be essentially the same in the two groups.

These findings would suggest that, with reference to these criteria, the stuttering and non-stuttering subjects were affected alike by DAF.

The speech behavior of stutterers under NAF was compared with the speech behavior of non-stutterers under DAF with regard to the decrement of the frequency of error words over five readings of the passage (adaptation effect), the consistency of error words, and certain listener data. (An error word was a word in which any portion of an instance of omission, substitution, or addition of sounds occurred). No statistical analyses of the adaptation data or the consistency data were done since group differences would have been confounded with experimental treatment differences.

The error word adaptation percentages for the stutterers over the five readings under NAF were quite similar to stuttering adaptation percentages quoted in the literature. The error word decrement for the non-stutterers under DAF, however, was erratic and otherwise dissimilar to that of the stutterers.

The mean percentage of consistency of error words for stutterers over the five readings under NAF was 51 per cent, while that for the non-stutterers over the five readings under DAF was 26 per cent.

Listeners were asked to distinguish, from recorded speech samples, the stutterers reading under NAF from the non-stutterers reading under DAF. Of the 828 judgments made, 79 per cent were correct; the correct judgments were significantly different from chance at the one per cent level. Listeners were also asked to determine if the stuttering subjects represented on a prepared tape were reading under NAF or DAF. The listeners were 93 per cent correct in these judgments. These findings would seem to suggest that the auditorily perceptible aspects of stuttering behavior and DAF behavior are different.

All stuttering subjects were interviewed regarding their experience speaking under DAF. Eighteen of the 23 subjects stated unequivocally that they recognized differences between their usual stuttering and their DAF speech behavior, one subject reported that he could not recognize such differences except for a change in the time dimension of his speech under DAF, and the responses of four subjects were difficult to interpret for various reasons, but indicated that they made certain differentiations between their stuttering and their speech under the DAF condition.

It seems, with reference to the measures used in this experiment, that there may be differences between stuttering behavior and DAF speech behavior. The hypothesis that stuttering may be somehow related to a delay in auditory feedback, on the ground that speech produced under conditions of delayed auditory feedback appears to behave



like stuttering, to sound like stuttering, and to be an experience like stuttering, seems to have been weakened by the findings of this experiment.

Microfilm \$2.50; Xerox \$6.80. 143 pages.

# THE PERCEPTUAL SIGNIFICANCE OF CERTAIN ACOUSTICAL CORRELATES OF CONSONANT VOICING CONTRASTS

(L. C. Card No. Mic 60-5688)

John Douglas Noll, Ph.D.  
State University of Iowa, 1960

Chairman: Professor James F. Curtis

The present study was undertaken in order to add further information regarding the perceptual significance of certain acoustical features thought to be associated with consonant voicing contrasts. By means of special re-recording and tape editing procedures nonsense syllables as recorded by three speakers were experimentally manipulated so as to give those syllables which originally contained voiced consonants certain acoustic features more typical of voiceless consonants. Conversely, the syllables which were originally recorded with voiceless consonants were altered so as to give them acoustic features more typical of voiced consonants. Those syllables containing voiced consonants were treated in the following ways: (a) vowel duration shortened to corresponding vowel length in syllables containing voiceless consonants, (b) consonant duration lengthened to corresponding consonant length in syllables containing voiceless consonants, (c) vowel first-formant transitional movements removed by filtering out entire first formant, and (d) low-frequency energy in the consonants removed by filtering procedures. These treatments were performed singly and in all possible combinations. The syllables containing voiceless consonants were treated in the following ways: (a) vowel duration lengthened to corresponding vowel length in syllables containing voiced consonants, (b) consonant duration shortened to corresponding consonant length in syllables containing voiced consonants, (c) vowel first formant removed, and (d) low-frequency energy of voiced consonant added to the voiceless consonant. For these syllables as well, treatments were performed singly and in all possible combinations. The resulting stimuli were presented to fifty listeners who indicated whether the consonants were heard as voiced or voiceless.

The results of the listener responses to the experimental syllables yielded the following generalizations:

- (1) On the whole the effects of treatments were reasonably similar from speaker to speaker with only two significant exceptions. Thus, with the exceptions noted, one can seemingly generalize concerning the treatment effects without regard to inter-speaker variations.
- (2) The data show a marked interaction between treatments and phonemes for certain of the experimental conditions. Hence, it is not possible, in some cases, to infer that the factors involved in these

interactions will have general significance for all voiced-voiceless contrasts.

- (3) None of the treatments or treatment combinations produced a marked effect on the voiced consonant syllables. This is interpreted as evidence that the voicing information carried by the periodic component of the voiced consonant spectra, which was not altered very greatly by any of the treatments, is a dominant factor in conveying an impression of voicing.
- (4) The voiceless consonant syllables showed considerably greater perceptual alterations resulting from the experimental treatments. The one experimental treatment which had the most consistent influence in changing the perception of the voiceless consonants was the addition of periodic low-frequency energy to the consonants. This was the only experimental effect which appeared to be sufficiently consistent, and of great enough magnitude, to justify interpretation as having general significance in relation to all voiced-voiceless phoneme pairs considered in this study.
- (5) Phoneme duration and first-formant transitions were shown to have some effect on the voiceless consonants, particularly in the post-vocalic position, but these treatment effects were less consistent and of smaller magnitude than those associated with adding a periodic component to the consonant spectra.
- (6) From the evidence previously summarized it seems reasonable to interpret the results of this study as indicating that presence or absence of periodic components in the consonant spectra is the most significant factor influencing the perception of voicing and that other factors appear to be of secondary significance.

Microfilm \$2.50; Xerox \$5.20. 103 pages.

# SOME ACOUSTIC CONCOMITANTS OF CHRONIC NON-SPECIFIC LARYNGITIS

(L. C. Card No. Mic 60-5835)

Audrey O'Brien O'Brien, Ph.D.  
Columbia University, 1960

The problem was basically to investigate by means of subjective judgment and acoustical analysis what kind of voice quality is produced by a larynx which has undergone any of the tissue changes classified as chronic non-specific laryngitis. Secondary goals were the exploration of the usefulness of the sound spectrograph for research on voice quality and the provision of objective data on which the definitions of some terms used to define voice qualities might be based. The subjects were nine men who had had a diagnosis of chronic non-specific laryngitis (cns1), and nine men who had not. Their voices were recorded while they said four sentences. Ten expert judges rated the voices on over-all quality and on breathiness, huskiness, hoarseness, harshness, raspiness, denasality, nasality, metallic tone, stridency, muffled tone, and throatiness.

Spectrograms were made of one sentence on the recorded samples, and oscillograms were made of one word. Four judges ranked the spectrograms on two physical features.

The conclusions were that the voices of men who have chronic non-specific laryngitis differ from "normal" voices in that they are heard to have:

1. Poorer tone quality.
2. A greater degree of perceived breathiness, huskiness, hoarseness, harshness, and raspiness.
3. Possibly a greater degree of denasality, nasality, muffled tone, and throatiness, but these scores were not reliable.

Stridency and metallic tone were not present to a significantly greater degree in the voices of the cnsl group. The judges were able to guess which subjects had laryngitis.

In both groups, scores on huskiness, hoarseness, harshness, and raspiness are highly intercorrelated. In the control group, breathiness was also part of the constellation, while in the cnsl group, metallic tone and stridency are part of it, instead. The impression that in the cnsl voice there is more likely to be a closer relationship between faults indicating incomplete vocalization of air and faults indicating a particular kind of vocalization was confirmed by a factor analysis.

In each group, over 80 per cent of what constitutes the judged over-all quality and the seven clustered characteristics is accounted for by three basic factors. In a laryngitis voice, what is heard as huskiness or hoarseness is largely raspiness; whereas in a "normal" voice, huskiness and hoarseness are largely caused by the escape of unvocalized breath. One's evaluation of the over-all quality of a "normal" voice is influenced by both these factors, but one's evaluation of the over-all quality of a cnsl voice is independent of the presence or absence of breathiness.

In the cnsl voice there is a greater tendency for the distribution of acoustic energy throughout the frequency range to shift abruptly every three or four vocal cord cycles. On spectrograms, these abrupt changes in the spectrum appear as sharp changes in the darkness of the formants. The degree to which these shifts in spectrum occur bears a moderate degree of correlation with all the quality faults studied, except metallic tone and stridency, the same two which did not distinguish the groups. No feature of the spectrograms or the oscillograms seemed to be associated with any particular voice quality characteristic.

Microfilm \$2.65; Xerox \$9.25. 202 pages.

# AN ANALYSIS OF SELECTED ORAL COMMUNICATION ATTRIBUTES OF DIRECT-SELLING REPRESENTATIVES AS RELATED TO THEIR SALES EFFECTIVENESS

(L. C. Card No. Mic 60-6124)

Ralph Wayne Pace, Ph.D.  
Purdue University, 1960

Major Professor: Dr. W. Charles Redding

## Purposes

This study investigated the oral communication behavior of direct-selling sales representatives. The specific objectives were (1) to discover if, in terms of selected oral communication attitudes and practices, there were significant differences between "more successful" and "less successful" sales people; and (2) to discover if, disregarding differences in selling effectiveness, there were certain attributes of oral communication that seemed to be characteristic of sales people as a group.

## Methods and Procedures

A criterion measure of sales success was devised, called the "Sales Effectiveness Index" (SEI), computed by finding the quotient:  $\frac{\text{dollar value of sales}}{\text{time spent in selling}}$ . A neutral third party computed the indices in order to maintain objectivity during the data-gathering phases of the research.

Final phases of the study were conducted with 37 subjects, 20 "high-effectiveness" and 17 "low-effectiveness" sales people (selected by the SEI criterion). The subjects were all women (usually housewives selling on a part-time basis), working for a nationwide retail sales company.

Aspects of oral communication hypothetically relevant to selling were cast into various forms, chiefly interview questions. The "raw" data were gathered in interviews: by observing the respondents' behavior, by oral responses to questions, and by securing responses on written instruments.

Most of the data were coded in the form of dichotomized categories, then analyzed, basically, in two ways: by "differential" (chi-square) and by "modal" (binomial test) statistics. Items yielding statistically significant modal responses were submitted to a panel of "communication experts," for purposes of comparison.

## Results and Conclusions

A large number of specific results and conclusions emerged, of which only the most salient are stated below.

1. Of 117 communication items, 13 differentiated (at the .05 level of confidence) between the more effective and the less effective groups. At lower levels of confidence (.10 level and .20 level) 23 items indicated possible trends differentiating the two groups. However, the results on twelve of these 36 items (two at the .05 level or above, four at the .10 level, and six at the .20 level) were in the direction opposite to that hypothesized.

2. Very few of the items found to differentiate between the groups dealt with generalized aspects of communication behavior. (However, relatively few of the 117 communication items were intended to deal with such aspects).



3. As estimated by interviewer's evaluations, the more effective sales persons were rated higher on "communication skill" than were the less effective.

4. When "summated" ratings were computed for the entire sample on six specific aspects of oral communication skill, about half of them emerged with scores of "average" or better. However, in terms of ratings based upon "over-all" (Gestalt) impression of communication skill, the group as a whole scored "average" or below.

5. Except for "use of language," ratings on six separate aspects of oral communication skill, when analyzed one at a time, did not differentiate between the more effective and the less effective groups.

6. In terms of sheer number of detailed items, the entire sample (combining high's and low's) revealed attitudes or other kinds of behavior consistent with communication hypotheses almost 40 per cent of the time; and, inconsistent with communication hypotheses, only about 10 per cent of the time. There were 12 instances in which a panel of communication experts concurred that the positions indicated by the subjects were incompatible with "accepted principles" of communication.

7. There was widespread aversion to almost anything considered by these subjects as "high-pressure" selling.

8. Responses of all the subjects indicated little or no specific advance preparation for sales presentations.

9. When queried about 15 common sales techniques, the subjects revealed ignorance of all but four--and only a non-textbook awareness of these four.

Microfilm \$3.85; Xerox \$13.50. 299 pages.

#### A CINEFLUOROGRAPHIC STUDY OF THE ARTICULATORY MOVEMENTS OF SELECTED INDIVIDUALS WITH CLEFT PALATES

(L. C. Card No. Mic 60-5691)

Gene Roy Powers, Ph.D.  
State University of Iowa, 1960

Chairman: Professor Duane C. Priestestersbach

The purpose of the study was to investigate factors which might differentiate between individuals with cleft palates who had similar degrees of velopharyngeal closure as determined from lateral head x rays but who differed markedly in articulation ability. Cinefluorography was chosen as the primary tool to use for investigations of factors relating to articulatory movements. Fourteen subjects were tested and placed in a good or poor closure group on the basis of the observation of single exposure, lateral head x rays taken during the production of /s/ and /u/. Seven subjects were placed in Group A because they exhibited velopharyngeal closure on at least one of the obtained x rays. The remaining seven subjects were placed in Group B since they clearly did not achieve velopharyngeal closure while the single-exposure x rays were being taken.

Articulation data, oral pressure measurements, and ratings of the oral structures from peroral examinations and dental casts were obtained for all of the subjects in addition to the single exposure and motion picture x-ray

data. The cinefluorographic films were made while the subjects sustained the /u/ and /s/ sounds, repeated the syllable /du/ at slow and rapid rates of utterance, and read a short passage. Two subjects were selected from each of the closure groups who demonstrated decided differences in articulation ability. Each pair of subjects was similar in age, sex, IQ score, and size of oral structures.

Portions of the cinefluorographic films from each type of speech sample from the final four subjects were analyzed frame-by-frame. Each of the frames from the selected portions were traced and measurements were made on each of the tracings. The measures obtained included incisal opening, tongue-velar distance, tongue-pharyngeal distance, velar-pharyngeal distance, and extent of closure. Satisfactory reliability for the tracing and measurement procedures was established.

Comparisons of the non-radiographic data were made between the two total groups, within each of the groups, and among the four final subjects. Attempts were made to make qualitative comparisons from the moving projections of the cinefluorographic films of the total groups as well as of the final four subjects. Comparisons were made between the single exposure and the cinefluorographic data while the subjects were producing /u/ and /s/. The effect of rate of utterance was examined by comparing the measurements obtained when syllables were spoken slowly with those spoken rapidly. Comparisons of the x-ray measurements obtained from the tracings representing portions of the reading passage were made between the two subjects in each of the groups.

Although the results were obtained from very few subjects, the following conclusions seem warranted:

- (a) Attempts to make qualitative comparisons from cinefluorographic films are not very productive. Quantification of movement patterns is highly desirable for such comparisons.
- (b) Systematic differences between cleft palate individuals with good velopharyngeal closure but divergent articulation skills may be accounted for by variation in dentition, motility of oral structures, site of velopharyngeal closure, tongue carriage and/or mouth opening.
- (c) Systematic differences between cleft palate individuals with inadequate velopharyngeal closure but divergent articulation skills may be accounted for by variation in dentition, alar constrictions, oral breath pressure, patterns of tongue movements, tongue carriage, and/or mouth opening.
- (d) Considerably different results may be obtained from averaging values of measures obtained from cinefluorographic tracings and from single exposure x-ray data when subjects produce the same phoneme.
- (e) Increased rate of utterance tends to decrease the magnitude of tongue activity for some subjects when repeating the syllable /du/.
- (f) Considerably more research is needed to determine the factors which differentiate between individuals with clefts and to what extent the results of pooled measurements can be meaningfully interpreted without reference to the anatomical and physiological conditions existing for specific speakers.

Further research with normal subjects is also needed in order to evaluate the results of the present study more adequately.

Microfilm \$2.50; Xerox \$6.40. 132 pages.

**AN INVESTIGATION OF THE METHOD  
OF DIRECT MAGNITUDE-ESTIMATION FOR  
SCALING DEFECTIVENESS OF ARTICULATION**

(L. C. Card No. Mic 60-5692)

Elizabeth Moodie Prather, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor Dorothy Sherman

The purpose was to study the psychological scaling method of direct magnitude-estimation for obtaining measures of defectiveness of articulation along a ratio scale. Test items were 27 tape-recorded five-second segments from the speech of children with a range of articulation from normal to severely defective. Observers were 200 university elementary psychology students. They were subdivided into five groups of approximately 40 observers each to meet the requirements of the experimental design.

Scale values consisting of arithmetic means were derived from data obtained under six conditions with differing instructions. Two standard stimuli were used: one of medium severity for five conditions and one of mild severity for the sixth condition. Specifically the six conditions were as follows: Condition I, standard stimulus of medium severity designated as 100 and presented only at beginning of stimuli; Condition II, standard stimulus of medium severity designated as 10 and presented only at beginning of stimuli; Condition III, standard stimulus of medium severity designated as 100 and repeated before every sixth speech segment; Condition IV, standard stimulus of medium severity designated by no specific point assignment, observers free to designate whatever number desired, and presented only at beginning of stimuli; Condition V, same as Condition I, with observers who had taken part in Condition IV exactly one week earlier; Condition VI, standard stimulus of mild severity designated as 10 and presented only at beginning of stimuli.

Evaluations of the scale values of the six conditions were made by comparing obtained sets of scale values with one another and with corresponding scale values obtained in a previous study (6) by the methods of equal-appearing intervals, of pair comparisons, and of constant sums. Intraclass correlation coefficients, Pearson correlation coefficients, demonstrations of linear relationships between sets of scale values, regression equations, and standard errors of estimate were used in the evaluations.

The results indicated that scale values do not depend upon whether a specific point assignment is given to the standard stimulus by the experimenter or whether the point assignment is left to the free choice of the observer. Results do vary, however, depending upon changes in the number of specific points assigned the standard stimulus by the experimenter; the scale is relatively extended at the upper end with the assignment of 10 points to the

standard stimulus as compared to the assignment of 100 points. Scale values do not depend importantly upon variation of the severity of the standard stimulus. There appears to be no important advantage in frequent presentation of the standard stimulus over a single presentation at the beginning of a judging session.

On the basis of the results obtained in this investigation it appears that the method of direct magnitude-estimation is useful for scaling defectiveness of articulation. Scale values were found to be reliable and the method practicable in terms of experimenter and observer time.

Microfilm \$2.50; Xerox \$3.80. 69 pages.

**THREE ORIGINAL PLAYS**

(L. C. Card No. Mic 60-5697)

Howard Richardson, Ph.D.  
State University of Iowa, 1960

Chairman: Associate Professor William R. Reardon

This is a creative thesis composed of three original plays. All are full length, the first two in three acts and the third in nine scenes.

The first play, Where There's a Will, is a folk comedy, laid in the Maritime Alps in France. It was produced by the State University of Iowa in the University Theatre, November 18 and 19, 1940. It was directed by Hunton D. Sellman. The play grows out of experiences of two summers I spent in the French Alps in 1938 and 1939. To my knowledge this is the first play to be written in English which deals with the people of this section of France. They are quite different from our southern mountaineers in that they live in towns and not in isolated cabins. Their chief and often only source of income is from their cows, which hold an important place in the community. Life in these mountains is hard and the people age rapidly. Their main interest outside their work is the Church, which has a strong influence upon them. This play was later rewritten into a television comedy under the title, My Friends the Birds. It was produced on film for ABC-TV and released nationally on the program Studio 57, August 12, 1957.

The second play, The Smiling Unicorn, is a melodrama, laid in Paris in August, 1939. It was produced by the State University of Iowa in the University Studio Theatre, July 16 and 17, 1941. It was directed by Marian Gallaway. I was a student in Paris during the two years immediately preceding World War II, and this play reflects some of the ideas prevalent among the people of France at that time. Written shortly after the fall of Paris to the Nazi invasion, it is an attempt to explain how the occupation could have been so successful with such apparent lack of resistance.

The third play, Barbara Allen, is a poetic fantasy of North Carolina mountain folk. A dramatic legend, it is laid in no specific time. It was produced by the State University of Iowa in the University Theatre, June 29 and 30 and July 1, 2 and 3, 1942. It was directed by Hunton D. Sellman.

In Barbara Allen I went back to my own North Carolina background and drew on folk material with which I have been familiar since a child. The play was later rewritten



with William Berney under the title, *Dark of the Moon*, and was produced successfully in New York City during the season of 1944-45, opening at the Forty-Sixth Street Playhouse on March 18, 1944. It has since been produced by over sixty American colleges and universities. It has had successful runs in England, Australia and South Africa, and a pirated adaptation in Russian is at present part of the permanent repertory of the National Theatre in Lenin-grad. The script was presented the Maxwell Anderson award for poetic drama in 1942 by Stanford University.

*Barbara Allen* is based on a legend, versions of which can be traced as far back in history as the 15th and 16th centuries in Europe. In adapting it to the theatre, I attempted to create a story that is both tragic and comic, terrifying as well as gay. I tried to show the innate piety and simple forthrightness of the Carolina mountain people in their home life, their occupations, and their religion. The underlying motif of the play illustrates the dangers to society that result from fear, superstition and hysteria, the threads of which run through much of our country's history. Microfilm \$3.90; Xerox \$13.75. 304 pages.

THE RELATIONSHIP OF STUDENTS'  
POLITICAL FRAME OF REFERENCE,  
CRITICAL THINKING ABILITY, AND  
OTHER VARIABLES TO THE RECALL AND  
RATIONALIZATION OF POLITICAL MATERIALS.

(L. C. Card No. Mic 60-5610)

Erhart Alfred Schinske, Ph.D.  
University of Minnesota, 1960

This study was designed to test the hypothesis:

"There is a positive relationship between student critical thinking ability and other variables, and student objectivity (freedom from tendency to seek conformity to political frame of reference), as evidenced in acts of recall and rationalization of political materials."

It was thought probable that if this positive relationship was manifest, high critical thinkers would demonstrate less tendency than low critical thinkers to recall and rationalize congruently with political frame of reference.

Listeners were 564 students in fundamentals of speech classes at the University of Minnesota in fall 1956. They completed the Watson-Glaser Critical Thinking Appraisal and the Gilkinson Personal Report on Confidence As a Speaker. Subjects were classified as high and low critical thinkers, confident and fearful speakers by halving distributions. Political frame of reference was stimulated by exposing subjects to a recorded speech consisting of 30 pro-Republican and 30 pro-Democrat statements. One-half of all listeners heard a pro-anti order of presentation evaluating the assets of candidates Eisenhower and Stevenson first and their liabilities second; the remaining half heard an anti-pro order. Listeners submitted answers to an information questionnaire and a retention test which provided opportunity to recall answers harmonizing with frame of reference or to rationalize answers conflicting with frame to create congruence.

Listeners were analyzed in (1) 12 single-variable

groups - high and low critical thinkers, for example; (2) 22 double-variable groups - high critical thinkers-confident speakers, etc.; (3) 32 triple-variable groups - high critical thinker-confident speaker-men, etc.

Statistical treatment employed three different applications of chi-square and the contingency coefficient for analysis of numbers of listeners responding congruently with frame. Calculation of critical ratio and analysis of variance were employed for analysis of numbers of statements recalled and rationalized.

Within the limits of the data a number of conclusions are offered:

1. Listeners in most groups recalled and rationalized significantly in favor of frame of reference.
2. The stronger the political attitude, the stronger the tendency to recall and rationalize congenially with frame.
3. A higher congruence was noted for recall and frame of reference than for rationalization and frame.
4. Both forms of presentation elicited responses harmonizing significantly with frame of reference, but neither form was superior.
5. More low-critical-thinker-C-D-grade students than high-critical-thinker-C-D-grade students recalled congruently with frame. More low-critical-thinkers than high-critical-thinkers rationalized to create harmony with frame.
6. Confident and fearful speakers did not differ in recall covaluent with frame of reference. More fearful-speaker Republicans than confident-speaker-Republicans rationalized favoring frame.
7. More Democrats than Republicans, and more freshmen-sophomores than juniors-seniors recalled congruently with frame.
8. More fearful-speaker-Republicans than fearful-speaker-Democrats, and more C-D-grade students than A-B-grade students rationalized in harmony with frame.
9. Men and women did not differ in either recall or rationalization.

Thus the hypothesized relationship between critical thinking ability and objectivity was realized only partly in recall but materialized to a larger extent in rationalization. Varied relationships between other variables and objectivity were observed.

Microfilm \$5.25; Xerox \$18.70. 412 pages.

THE POLITICAL SPEAKING OF  
HENRY F. SCHRICKER OF INDIANA

(L. C. Card No. Mic 60-6089)

Donald Richard Smith, Ph.D.  
Purdue University, 1960

Major Professor: H. L. Ewbank, Jr.

Henry F. Schricker has averred that he has spoken at everything from "a dog fight on up." Through fifty years as a reciter of Riley, a demonstrative speaker, and a candidate for offices ranging from County Clerk through State Legislator, Lieutenant Governor, Governor, and US Senator, this most beloved political figure has perhaps said "Mr. Chairman" more often than any other Hoosier.

Interviews with contemporaries and newspaper accounts

were the main sources of answers to such questions as: What was the socio-cultural context of his audience? What speech training did he receive? Of what influence was his early life and training on his speaking? What types of speaking did he do? What themes ran through his speeches? What were the rhetorical characteristics of his speeches? Upon what occasions did he speak? How did he prepare his addresses? Information from these primary sources led to an evaluation of the speaker and the speeches.

To the conservative Hoosier audience, moving with the years from agricultural to industrial orientation, Schricker offered his own absolutely untutored rhetoric.

Coming from immigrant parents he early gained respect for the poor and for the first and second generation American. In his strict one-room German Lutheran School he learned respect for God, for authority, and for his nation. These themes pervaded his speeches.

Schricker's speeches may be classified as "demonstrative," "legislative," and "political," but whenever Schricker spoke, no matter the occasion, he was aiding his political career.

The primary themes with which he dealt were: The Democratic Party and Henry Schricker Deserve Your Support on Election Day; Hoosiers Should Be Proud of Their State; Democracy and Freedom Must Be Fought For; Morality is Important; Education in Indiana Needs Improving; and Separation of Church and State Must Be Maintained.

Schricker developed his speeches using an introduction, body, and conclusion. His introductions were usually brief and his conclusions tended to be too long for utmost effectiveness. Smooth transitions were often lacking in the body of his speeches, as was evidence of such principles as unity, coherence, and emphasis. Generally his method of argument was to develop his points inductively, using didactic form. Argument by simple enumeration, by example, and by assertion predominate. Schricker's style was simple, colorful, and "folksy." It was one of his great strengths. Both the man and the style were eminently "Hoosier."

Schricker has spoken at such varying occasions as country festivals, church services, political meetings and conventions, labor meetings, and meetings of service clubs. He nominated Stevenson at the 1952 Democratic National Convention, and gave an address at the launching of the USS Indiana.

In preparing for his earlier speeches he would draw from his store of experiences and personal knowledge of history and often add quotations from clippings, editorials, and illustrations which he kept in cigar boxes. He then spoke extemporaneously with or without notes. After becoming Governor, he often sent his secretary to the State Library for information, or called in one of his department heads. He would then type his own speech manuscript on 5 by 8 sheets to be inserted into a binder. Except for broadcasts, campaign speeches were almost always extemporaneous.

His two greatest strengths were his unquestioned ethical image (symbolized by his "White Fedora") which reinforced the ethical appeals prevalent in his speaking, and his style which fit the Hoosier context so well with its "folksyness" and simple embellishments. These personal characteristics and the development of a style that met his audience on its own level were the salient features of Schricker's speaking. Microfilm \$5.30; Xerox \$18.70. 415 pages.

## CRITICAL REQUIREMENTS FOR THE ORAL COMMUNICATION OF INDUSTRIAL FOREMEN

(L. C. Card No. Mic 60-5462)

William Sanford Tacey, Ed.D.  
The Pennsylvania State University, 1960

Since World War II industrial management has become more aware of the problems of communication, particularly among front line foremen. In part, this awareness has been brought about by the choice as foremen of men who are accustomed to respecting the individual rights of employees. Such foremen replace those who used more authoritarian methods. Another factor which has increased the concern of management with communication has been the growing power of labor unions.

The purpose of this study was to prepare a list of the critical requirements for the oral communication of industrial foremen which might be used as standards of judgment by members of middle management in appraising their foremen's oral practices. The data were collected from members of middle management in the production departments of three United States Steel mills in the Pittsburgh area.

The critical incident technique was used in this study. Reasons for the choice were: 1) it could be specifically applied to the oral communication of foremen; 2) it permitted expression in precise and unambiguous terms; 3) it could be used to derive genuinely important requirements; 4) it is adequately comprehensive in scope; 5) it does not rely solely on subjective opinions of those from whom data are sought.

Members of middle management were consulted because they supervise the work of foremen. Immediate superiors of foremen are superintendents, assistant superintendents, and general foremen. They plan the work for foremen, instruct them, and give orders. They supervise foremen's work and hold foremen accountable for carrying out orders. They are concerned with the ability of foremen to communicate orally.

Three separate means were used to collect data. Fifty-nine men were interviewed and were asked to complete five-day diaries. Questionnaires were distributed to 200 men. By each of these means respondents were asked to describe incidents in which they had personally observed foremen speaking effectively or ineffectively. A limitation of one year was put upon recalled incidents. From all incidents reported 676 behaviors were selected.

By carefully classifying the behaviors 100 at a time, the discovery was made that as few as 400 behaviors yielded sufficient data from which to draw a valid conclusion. Addition of the next 276 behaviors merely confirmed what was originally learned.

The list of critical requirements discovered was assembled under areas, sub-areas, and classes corresponding to those under which the incidents were classified. There were three broad areas of oral communication by foremen: 1) with superiors, 2) with subordinates, and 3) with other foremen. The relatively small number of major areas of the classification tends to show that the speaking which foremen do is of relatively limited variety. The large number of minor classifications (168) indicate that within these limitations foremen find numerous opportunities for speaking, and that much is expected of them by their superiors.



This study presents specific data to support what has been heretofore believed about the oral communication of foremen but not proved. Administrators in industry and other fields may find the list of critical requirements, or

the methods of evolving them, helpful in discovering the speech requirements of people at various levels of management or in various occupations.

Microfilm \$2.50; Xerox \$8.60. 186 pages.

## ZOOLOGY

THE BIOLOGY AND TAXONOMY OF  
WISCONSIN BLACK FLIES  
(DIPTERA: SIMULIIDAE).

(L. C. Card No. Mic 60-5709)

John Richard Anderson, Ph.D.  
The University of Wisconsin, 1960

Supervisor: Associate Professor Gene R. DeFoliart

Twenty-seven described species of the genera *Prosimulium* Roubaud, *Cnephia* Enderlein, *Eusimulium* Roubaud, and *Simulium* Latreille were recorded from Wisconsin, 22 of them for the first time. Five other unidentified species were also found. Three of these were collected only in the larval stage. Of the remaining two, one was found only in the pupal stage, whereas the other is known only from several females. Their specific determinations await the discovery and association of all stages and a study of the larval chromosomes. The previously unknown larvae of *Eusimulium croxtoni* (N. & M.) and *Simulium rugglesi* N. & M. were discovered and correctly associated with their corresponding pupal and adult stages.

Nine species were found feeding only on mammals, whereas five were ornithophilic. Two of the mammal and 26 of the avian host records are believed to represent new simuliid-host associations. The unusual circumstance in which the ornithophilic species, *Simulium meridionale* Riley fed on man is discussed. Four mammalophilic species were occasional livestock pests.

*Leucocytozoon simondi* M. & L. was experimentally transmitted to domestic white Pekin ducklings by subcutaneous inoculations of infected *Simulium rugglesi* females, and the sexual stages of *Leucocytozoon smithi* (L. & L.) of turkeys were observed in sectioned *Simulium meridionale* females that had fed on infected turkeys.

Four of six wild duck species and domestic white Pekin ducklings contracted natural infections of *Leucocytozoon simondi* while exposed in the field and fed on by the vector, *Simulium rugglesi*. Only domestic ducks died as a result of these infections. Gallinaceous birds fed on by the same vector species did not contract the disease. Mortalities in the exposed domestic ducklings resulting from *Leucocytozoonosis*, as well as the time intervals between infection and death, were directly related to the number of infected flies feeding on the ducks.

A rapid method of capturing flies after they were attracted to and had fed on experimentally exposed birds is reported, and habitat and host preferences of several ornithophilic species are discussed.

Eastern viral encephalitis was isolated from a pool of 100 non-engorged *Simulium meridionale* that were collected

in a turkey brooder house on June 8, 1960. This represents the first time this virus has been isolated from a simuliid. In addition to this single positive pool, 116 other pools consisting of 3403 specimens of six species collected in 1959 and 1960, all proved negative for any chicken embryo lethal agents.

Two new species of mermithid nematodes (*Hydromermis wisconsinensis* Welch, and *Gastromermis longispicula* Welch) were found parasitizing *Simulium vittatum* Zett. larvae. These represent the first North American records of free-living mermithid adults from a simuliid. Also, this is the first record of the genus *Gastromermis* Micoletzky occurring in North America. Observations on the detrimental effects of larval parasitism and development of the post-parasitic stages of the nematodes are reported. Seventeen species of simuliid larvae were found infested with mermithid nematodes.

Larvae were found to feed primarily on diatoms and other algae, some of which were scraped from the substratum. Waters containing large amounts of eroded soil particles and other detritus were unfavorable habitats for the larvae of most species, as the larvae appeared incapable of selective feeding and their intestinal tracts often contained more sand and silt than diatoms and other algae; large soil particles were rejected, however, or perhaps were not small enough for ingestion.

Microfilm \$2.55; Xerox \$9.00. 196 pages.

LARVAL RESISTANCE AND HISTOPATHOGENESIS  
IN TWO GENETICALLY DIFFERENT LINES OF  
HONEY BEES (*APIS MELLIFERA* L.) FED SPORES  
OF *BACILLUS* LARVAE WHITE

(L. C. Card No. Mic 60-4888)

John Francis Bamrick, Ph.D.  
Iowa State University of Science and Technology, 1960

Supervisor: Walter C. Rothenbuhler

As far as is known all very young honey-bee larvae are highly susceptible and all older larvae are completely resistant to *Bacillus* larvae, the causative agent of American foulbrood. The progress of development of this maturation immunity to *B. larvae* was studied in larvae of two lines of honey bees -- one resistant and one susceptible. These investigations were designed to measure the mortality resulting from a constant dosage applied at different larval ages, to learn the magnitude of the differences between the two lines at each given age, and to take the first

steps toward discovering the basis for the differences between the two lines and between larvae of one line at different ages.

Test larvae were secured that ranged in age no more than six hours and all ages were studied from 0-6 to 66-72 hours. Paired samples of larvae from the two lines were reared in single nurse colonies. Inoculation consisted of depositing *B. larvae* spores onto the larval food by means of a microsyringe.

Brood of both lines had a high rate of mortality for the earliest inoculation age. In the resistant line mortality decreased immediately as inoculation age increased. There was a delay of about 12 hours before mortality decreased significantly in the susceptible line. The maximum difference between lines occurs at an average inoculation age of 15 to 21 hours. Larvae are no longer susceptible after about 36 hours in the resistant line and 48 hours in the susceptible line. Mortality of control larvae in both lines was relatively low for all inoculation ages.

A number of larvae and pupae of the same two lines of honey bees, inoculated at 0-6 hours of age, were randomly selected at 1, 1½, 2, 2½, 3, 4, 4½, 5, 6, 7, 8, and 9 days of age for a histopathological study. The individuals were fixed in alcoholic Bouin's, dehydrated, and embedded in paraffin. Serial sections were cut at 10 microns thickness. MacCallum-Goodpasture stain for bacteria in tissues was used.

The results of the histopathological study are as follows: *B. larvae* spores germinated in the midgut of the larvae and the vegetative cells penetrated the gut wall and invaded the body cavity in from 1½ to 7 days, apparently by histolysis of the epithelium. Lightly scattered bacteria in the body cavity of either young or old larvae did little or no visible damage. In younger larvae, heavy concentrations of bacteria produced local destruction of all tissues. In older larvae and pupae, the bacteria were most numerous in intercellular spaces and around epithelial linings, apparently producing a general septicemia and eventual destruction of almost all body tissues. There were no obvious differences in the progress of the disease in the larvae of the two lines, when inoculated at this early age.

Microfilm \$2.50; Xerox \$5.00. 97 pages.

#### THE SYSTEMATICS AND BIOLOGY OF THE DARTERS OF THE SUBGENERA *HOLELEPIS* AND *VILLORA* (PISCES, PERCIDAE).

(L. C. Card No. Mic 60-6500)

Bruce Baden Collette, Ph.D.  
Cornell University, 1960

This study was primarily directed toward clarifying the taxonomic relationships within two groups of *Etheostoma*, the subgenera *Holelepis* and *Villora*. Investigations on habitat, species associates, habits, and predators were also included. Twenty-six taxonomic characters were employed and over 6,000 specimens were examined. Drawings of the types of genital papillae and the distribution of breeding tubercles, photographs of both sexes of forms recognized here and of the habitats of some species, and distribution maps are presented.

*Etheostoma edwini* was shown to differ markedly from the species of *Holelepis* in the structure of the genital papilla, lack of breeding tubercles and the presence of red spots on the body of the breeding male, the reduced number of unpored lateral line scales and other characters. Therefore, *edwini* was placed in the subgenus *Villora* Hubbs and Cannon.

The subgenus *Holelepis* includes eight forms of small specialized darters: four are found in the swamps, lakes, and backwaters of the Coastal Plain of eastern North America (*fusiforme fusiforme*, *fusiforme barratti*, *ser-riferum*, and *zoniferum*); one in the lowlands of the Mississippi Basin (*gracile*); and three in the backwaters of Atlantic Piedmont streams (*collis collis*, *collis new* subspecies, *saludae*).

A new subspecies of *Etheostoma collis* is recognized from the Roanoke and Neuse rivers. *Etheostoma ser-riferum* can be divided into two races. *Etheostoma gracile* shows considerable intrapopulation but very little interpopulation variation. *Etheostoma zoniferum* is clearly an offshoot of *E. gracile*.

The most variable species of the group, and the one studied most intensively is *Etheostoma fusiforme*. There are three types of variation in this species: (1) Variation from population to population in an apparently random fashion (e.g. second dorsal rays); (2) clinal variation shown in the increased development of scalation, the increased per cent of individuals with 1 + 3 infraorbital pores and partially serrate preopercles; (3) variation in the retention of juvenile characters (neoteny). Neoteny was particularly evident in the greatly reduced number of pored lateral line scales in the dark North Carolina Bay Lakes and in clear Crystal Lake, Georgia, both areas of low productivity. It was also noted in the failure of the supratemporal canal to become closed, in the reduced number of scales above and below the lateral line, and in the reduced number of infraorbital pores.

*Etheostoma fusiforme*, *barratti*, and *thermophilum* are believed to be conspecific; the differences between them are of clinal and developmental nature. The subspecies of *fusiforme* recognized by Hubbs and Cannon (1935) were based upon a combination of random variation, developmental variation, and clinal variation so *f. insulae*, *f. metagadae*, *f. erochrous*, and *f. atraque* are synonymized with *f. fusiforme*. *Etheostoma thermophilum oligoporum* (J. R. Bailey and Frey) is considered to be based upon neotenic populations that have been produced independently in three of the dark North Carolina Bay Lakes. *Etheostoma thermophilum thermophilum* and *E. thermophilum oligoporum* are synonymized with *f. fusiforme*. *Etheostoma fusiforme fusiforme* differs from *E. f. barratti* in having fewer interorbital scales, less developed scalation of the breast and parietal, and fewer individuals with 1 + 3 infraorbital pores and partially serrate preopercles. *Etheostoma barratti appalachia* (J. R. Bailey) is considered a slightly differentiated introduced population of *f. barratti* which is not worthy of subspecific recognition.

Microfilm \$4.85; Xerox \$17.10. 380 pages.



COLORIMETRIC AND CHROMATOGRAPHIC  
DETERMINATION OF EXCRETORY STEROIDS  
IN NORMAL AND ESTRADIOL  
TREATED LARVAL FROGS

(L. C. Card No. Mic 60-5646)

Edwin Dale, Ph.D.  
State University of Iowa, 1960

Chairman: Professor Emil Witschi

The present investigation was undertaken to see if it might be possible to characterize biochemically some of the steroid constituents of the excretory material from normal and estrogen treated larval frogs. The results of an investigation of this type could be advantageous in providing an answer for the questions raised in the literature concerning the nature of androgen secretion in frog larvae with adrenal hyperplasia.

Excretory material from control and estrogen treated frog larvae at Stages 23 - 32 were analyzed for steroid content by colorimetric and proper chromatographic techniques.

No steroid material was detected in the excretory material from larvae at Stages 23 - 25 by either method. 17-Ketosteroid material (androsterone) was determined quantitatively from the total neutral fraction of the excretory material of larvae from Stages 26 - 32 and was found to be excreted in significantly different amounts between control animals and estrogen treated animals with adrenal hyperplasia. Hydrocortisone, aldosterone and 17- $\beta$ -estradiol were qualitatively identified from the excretory material of both the normal control and estrogen-treated larvae of both species studied.

The results are discussed as they relate to certain aspects of sex differentiation in larval frogs and also to the literature dealing with steroids in poikilothermic vertebrates. Microfilm \$2.50; Xerox \$3.00. 44 pages.

STRUCTURE AND ENERGY REQUIREMENTS  
OF PEROMYSCUS POLIONOTUS POPULATIONS  
IN THE OLD-FIELD ECOSYSTEM

(L. C. Card No. Mic 60-4651)

Leslie Bryan Davenport, Jr., Ph.D.  
University of Georgia, 1960

Supervisor: Eugene P. Odum

A live-trapping study of the role of *Peromyscus polionotus* in the old-field ecosystem was made in two fields of differing soils and vegetational covers on the AEC Savannah River Plant property in South Carolina. Home range data were analysed by four methods with the inclusive boundary strip method being preferred. Analyses of population dynamics, of spatial relationships among the mice, and of energy relationships relative to net primary production in the trapping areas were made, and comparisons made between the populations in the two fields.

The data revealed no statistically significant differences between home range sizes for males and females in any season, nor among home range sizes in different

seasons for all adults. Significant differences were found between home range sizes in the different fields and years of study. The animals did not exhibit territorial behavior. The mean home range size for adult *P. polionotus* during the study was found to be  $0.34 \pm 0.02$  acres, with a standard deviation of 0.17.

Mouse populations were almost identical on the two grids in 1953 and in comparable seasons in one field in 1954-55. No mice were found in the second field in the second year of study.

Populations highs occurred in spring (April-May), lows in late fall and winter. The greatest density recorded was 8.5 per acre, the smallest 1.7.

Breeding activity was lowest in December and January, but some pregnant females were found at all seasons. The sex ratio was approximately 1:1.

The mean weight of the species was  $13.22 \pm 0.09$  g., with a standard deviation of 1.65. Females were significantly larger than males.

Mice of the same sex were distributed at random with regard to one another in fields regardless of population density. Distances between males and females tended to remain constant at all seasons.

The mean caloric value of tissue for this species is 5.98 kcal/g. dry wt., or 1.94 kcal/g. live wt. Oxygen consumption was  $43.2 \pm 1.53$  ml/hour with a standard deviation of 11.2, or 3.27 ml/g. body wt/hour. The mean minimum (standard metabolism) energy requirement for adult *P. polionotus* was  $0.015 \pm 0.008$  kcal/g. body wt/hour with a standard deviation of 0.0058. The mouse populations were found to use less than 1.0% of net plant production in the fields, and less than 10.0% of estimated seed production.

Microfilm \$2.50; Xerox \$5.60. 114 pages.

STUDIES ON THE PHYSIOLOGY  
OF ACANTHOCEPHALA

(L. C. Card No. Mic 60-6103)

Tommy Tolson Dunagan, Ph.D.  
Purdue University, 1960

Major Professor: R. M. Cable

*Neoechinorhynchus* spp. survived longest at pH 7.0-8.4 under aseptic conditions in Tyrodes balanced salt solution and survival was prolonged to a maximum of 96 days by the addition of carbohydrates and/or serum as compared to 26 days in saline alone. Glucose was more effective than disaccharides but no difference was observed in the effect of turtle and calf sera. Survival was correlated with the depletion of glycogen, the rate of which was retarded as greatly by 0.1% as by 1.0% glucose. Although the parasites were found to contain lactic acid dehydrogenase and aldolase, neither the addition of phlorizin to the medium nor absence of oxygen affected survival, thus indicating that the cytochrome system as generally conceived is not operative in the species studied.

Seven free amino acids in addition to six previously reported, were found in *Macracanthorhynchus hirudinaceus* but none were detected in species of *Neoechinorhynchus* in the quantities of worm material available. The protein of *N. emydis*, *N. pseudemydis*, and *M. hirudinaceus* were

found to contain the same 18 amino acids with a close correlation between their quantities in the two species of *Neoechinorhynchus*. However, differences in species and also in sexes thereof were detected in peptides obtained by tryptic digestion of heat denatured proteins and subjected to electrophoresis followed by chromatography.

Microfilm \$2.50; Xerox \$4.80. 95 pages.

HOST-PARASITE RELATIONSHIPS OF  
*HAEMOPROTEUS SACHAROVII* NOVY AND  
MACNEAL, 1904 (PROTOZOA: SPOROZOA).

(L. C. Card No. Mic 60-4894)

John Neville Farmer, Ph.D.

Iowa State University of Science and Technology, 1960

Supervisors: Martin J. Ulmer and  
Elery R. Becker

During the period 1957 to 1959, 1,006 blood smears from 568 birds were examined, with 99 being found to harbor blood parasites. Of 41 mourning doves examined, 22 were infected with *Haemoproteus sacharovi* Novy and MacNeal, 1904. *H. sacharovi* infections were also demonstrable in 50 of 414 pigeons examined from a pigeon colony at Gilbert, Iowa. The blood of 37 feral pigeons, however, was parasite-free. An apparent relationship between the age of pigeons and their susceptibility to *H. sacharovi* infections is indicated, since infections were limited to pigeons two to six weeks old. Infections in these pigeons were also limited to an interval of approximately 14 weeks during the summer; namely, the middle of June to the end of September.

Gametocyte development of *H. sacharovi* was studied in mourning doves and pigeons. No differences were observed either in the morphology or rate of development of gametocytes in these hosts. The parasites apparently reach their full size within three-and-a-half to four days. Complete measurements of erythrocytes infected with micro- and macro-gametocytes from pigeons and doves indicate a distinct hypertrophy of infected host cells.

The phenomenon of exflagellation of *H. sacharovi* was observed in blood withdrawn from infected mourning doves and pigeons.

The reappearance of young gametocytes of *H. sacharovi* in the blood of infected mourning doves after gametocytes apparently disappeared from the peripheral circulation is attributed to a relapse phenomenon. Experimental evidence indicates a lack of periodicity in the reappearance of gametocytes. Variation in the frequency of relapse from bird to bird was also recorded. Since the doves were maintained under uniform conditions of light, food, water and temperature, some other factor, apparently, is responsible for differences in frequency of relapse among individual doves. Relapse of *H. sacharovi* infections was not demonstrable, however, in infected pigeons.

The area for exoerythrocytic development of *H. sacharovi* in the mourning dove was not found. However, gizzard lesions observed in infected pigeons are suspected to be the site of exoerythrocytic development of *H. sacharovi* in the pigeon. The evidence, however, is not yet conclusive.

Attempts to transmit *H. sacharovi* to laboratory-reared pigeons by the bite of mosquitoes, biting midges, hippoboscids, stable flies and black flies were unsuccessful. Similar results were recorded while attempting to transfer infections of *H. sacharovi* to pigeons using tissue transplants, inoculations of comminuted insects and macerated tissue.

The invertebrate host(s) responsible for the transmission of *H. sacharovi* was not found. However, in view of the absence of hippoboscid flies, the invertebrate host responsible is probably some other ectoparasite. Since mourning doves and pigeons, examined locally, were remarkably free of ectoparasites of any kind, the definitive host for *H. sacharovi* is probably a transitory parasite, remaining on these birds only for short periods of time.

Microfilm \$2.50; Xerox \$6.60. 136 pages.

THE ANATOMY AND GROWTH PATTERN  
OF THE CLASPERS AND SIPHON SACS  
OF THE SPINY DOGFISH, *SQUALUS ACANTHIAS*  
LINNAEUS, AND THE SMOOTH DOGFISH,  
*MUSTELUS CANIS* MITCHILL.

(L. C. Card No. Mic 60-6464)

Gordon Wayne Heath, Ph.D.

Cornell University, 1960

The present investigation dealing with the Spiny Dogfish (*Squalus acanthias* Linnaeus) and the Smooth Dogfish (*Mustelus canis* Mitchill) is concerned with: a description of the skeleton and musculature of the claspers, a histological and histochemical study of the siphon sacs, a brief report on the testis-epigonal organ complex, growth rates of the claspers and siphon sacs correlated with total body length and with the onset of sexual maturity, and a discussion of possible functions of the claspers and siphon sacs.

Twenty-one live and 73 preserved Spiny Dogfish were examined. Sixty-nine live and 26 preserved Smooth Dogfish were also studied. Measurements were made of total body length, clasper length, and siphon sac length of both species. Siphon sac tissues were preserved in various fixatives for histological and histochemical study. The testes, epigonal organs, pelvic girdle, pelvic fins, and claspers were preserved for further examination. Electrical stimulation of clasper muscles in living animals aided in studying their function.

Detailed descriptions and a comparison of the clasper cartilages and musculature of both species are presented. The skeleton of the pelvic fin and clasper consists of: basal elements, the propterygium and metapterygium; radial cartilages and ceratotrichia; intermediate elements, the joint cartilage and beta cartilage; and the clasper consisting of the stem cartilage, to which the marginal cartilages are fused, and the terminal cartilages. There are four terminal cartilages in the Spiny Dogfish clasper; eight in the Smooth Dogfish. The clasper musculature of the two species differs only in details. These muscles are found: the extrinsic dorsal radial, intrinsic dorsal radial, ventral radial, adductor, flexor (dorsal, middle, and ventral), dilatator, outer lip, and compressor. The action of each of these muscles is described.

The wall of the siphon is composed of four well defined



layers of tissue. It is the epithelial layer bordering the lumen which differs most in the two species. The Spiny Dogfish siphon sac secretion is a clear, viscous, fluid having the physical and staining properties of a mucus or mucus-like polysaccharide-protein complex and possibly phenolic substances of unknown composition. The mucoid moiety probably consists of a mixture of mucoproteins and a small amount of acid mucopolysaccharides. The secretion of the Smooth Dogfish siphon sac is composed of a mucus-like polysaccharide-protein complex. The major portion of the polysaccharide moiety is an acid mucopolysaccharide, although mucoproteins are probably present.

The epigonal organ, only partially surrounding the testis in both species, consists of lymphoid tissue which is probably hemopoietic. Measurements show the relation of body length and sexual maturity to length of the claspers and siphon sacs. The claspers of Spiny Dogfish grow most rapidly during the period when the animal increases from 48 to 58 cm. in length. The siphon sacs grow most rapidly when the animals increase from 50 to 60 cm. in length. The claspers of Smooth Dogfish display a period of rapid growth when the animals measure 73 - 83 cm. in length. Very rapid growth of the siphon sacs occurs when Smooth Dogfish measure 76 - 88 cm. in length.

The following view is presented to express the most probable function of the siphon sac and clasper. The clasper, which has been lubricated by a portion of the secretion from the siphon sac, is antero-flexed and then inserted into the oviduct of the female. It is anchored there by the terminal cartilages which are flexed after insertion. The compressor muscle forces the secretion of the siphon sac out through the clasper groove into the oviduct. Spermatozoa which have passed from the urogenital papilla into the clasper groove are carried into the oviduct by this secretion.

An unequivocal declaration of the function of the siphon sacs and claspers must await further investigation.

Microfilm \$4.70; Xerox \$16.65. 366 pages.

#### A SURVEY OF THE FISHES OF THE LOWER COASTAL PLAIN OF ALABAMA

(L. C. Card No. Mic 60-4703)

Andrew Frederick Hemphill, Ph.D.  
University of Alabama, 1960

A taxonomic survey of the fishes of the lower coastal plain region of Alabama, based primarily upon specimens in the University of Alabama Ichthyological Collection, was conducted from August, 1953, through August, 1959.

A total of 136 species and subspecies of fishes, representing 30 families, and including both fresh-water and marine forms were recorded.

Keys for the identification of the various species, diagnostic descriptions, and notes on their distribution and habitats are presented.

Microfilm \$4.80; Xerox \$16.90. 373 pages.

#### HABITAT-RELATED VARIABILITY IN THE CAVE-DWELLING MINNOW, *Hybopsis harperi*.

(L. C. Card No. Mic 60-5135)

John F. Howell, Ph.D.  
The University of Florida, 1960

The variation of 13 morphometric characters and 5 meristic characters was studied in samples of *Hybopsis harperi* from its two distinct, apparently isolated habitats: clear, free-flowing streams and sink holes with no current. The analyses of variance did not reveal any reliable character for distinguishing between fish from sink holes, which have been described as a separate subspecies, and those from streams, heretofore designated as the typical subspecies.

When 12 morphometric characters were subjected to an analysis utilizing Mahalanobis' Generalized Distance Function ( $D^2$ ) and a clustering technique, the samples from streams form one distinct cluster and the samples from sink holes form clusters removed from that one.

A model for morphometric divergence is suggested, in which change is interpreted as movement along one of the two major axes in the 12-dimensional hyperspace through which the samples are distributed by the Distance Function. One axis appears to correspond to the range of variation of sink hole populations and the other to the stream habitat.

Since, under this model, the clusters of sink hole samples were distributed in both directions from the intersection of the two axes, the recognition of two, and only two, subspecies is questioned.

Microfilm \$2.50; Xerox \$4.80. 93 pages.

#### POPULATION STUDIES ON *Neodiprion swainei* MIDDLETON (HYMENOPTERA: DIPRIONIDAE) IN QUEBEC.

(L. C. Card No. Mic 60-3527)

Leslie Allan Lyons, Ph.D.  
University of Minnesota, 1960

The spatial distribution, fecundity and some aspects of mortality of *Neodiprion swainei* were investigated in stands of jack pine (*Pinus banksiana* Lamb.) in northwestern Quebec. Larvae of this insect feed colonially on jack pine needles mainly in August and September, and overwinter in cocoons in the soil. Adults are active in June and July. Eggs are deposited on elongating current year needles; each female apparently oviposits in a cluster on a single terminal.

Egg cluster density is directly related to tree size and height in the tree, probably due to the photopositive behavior of ovipositing females. Frequency distributions of egg clusters per tree, disregarding tree size, are highly aggregated; within uniform size classes, however, egg cluster distribution approaches randomness, suggesting that aggregation is a consequence of the variation in tree size rather than gregariousness of ovipositing females. There is a barely detectable relation between cocoon

density and distance to the nearest tree in closed stands, although such a relation is evident around isolated trees. In plots several acres or more in size, frequency distributions of cocoons per square foot of soil area conform closely to negative binomial distributions with  $k$ -values between 1 and 4, depending on the stand. Within smaller areas, however, cocoon distribution tends toward randomness, which indicates that aggregation is the result of local heterogeneity in cocoon density.

Female *N. swainei* adults from field populations in Quebec have mean fecundities of 60-65 eggs, while those from an infestation in Wisconsin average 100-110 eggs. There is a good linear relation between fecundity and cocoon width, which seems to be the same for most samples. Sawflies subjected to partial starvation in the late larval stages produce small females of low fecundity, but do not differ from field-collected sawflies in the fecundity-cocoon size relationship. There is a direct curvilinear relationship between fecundity and oocyte length. Mean egg cluster size is slightly smaller than mean fecundity of females, probably because some females do not oviposit fully.

Egg parasitism by two species of Eulophidae occurred in a stand of very small trees, but was absent from closed stands. Parasitism varied indirectly with egg cluster height and directly with cluster size.

Heavy larval mortality occurs shortly after hatching; survival at this time is directly related to the number of larvae in the colony, which illustrates the value to the species of the group-feeding habit. It is postulated that anything causing a reduction in egg cluster size will bring about reduced survival of subsequent larvae. Partial starvation of larvae, egg parasitism, and other egg mortality might have this effect.

Mortality in the cocoon stage is attributable mainly to mammalian predators and insect parasites. Mammal predation was consistently greater on males than on females, probably due to the response of the predators to differences in cocoon size. Tachinid parasitism in cocoons was greater among females, but the discrepancy is attributed to premature mortality of parasitized male larvae rather than to selective behavior of adult tachinids. Heavy mortality may occur during the movement of the population between the tree crown and ground environments, i.e. in the fall when larvae leave the trees and spin cocoons in the soil, and again in the spring when adults emerge from cocoons and oviposit on tree terminals.

Cocooned larvae of *N. swainei* undergo a diapause, which, under some conditions, may be prolonged for one or more years. Climatic control of the proportion of sawflies remaining in diapause is suggested as an explanation for the observed correspondence between widely separated localities in the course of their annual fluctuations in density. Microfilm \$2.50; Xerox \$8.60. 190 pages.

# THE COMPARATIVE ECOLOGY OF THE KINOSTERNID TURTLES OF OKLAHOMA

(L. C. Card No. Mic 60-5191)

Ibrahim Younis Mahmoud, Ph.D.  
The University of Oklahoma, 1960

Major Professor: Charles C. Carpenter

A total of 1,200 field records was obtained for 911 individuals of the four species of kinosternid turtles known for Oklahoma: Mississippi mud turtle (*Kinosternon subrubrum hippocrepis*), Yellow mud turtle (*Kinosternon flavescens flavescens*), Stinkpot turtle (*Sternotherus odoratus*), Razor-Backed musk turtle (*Sternotherus carinatus carinatus*).

Information relative to habitat preference, temperature, diel cycle, seasonal periodicity, feeding habits, movements, growth, reproductive potential, behavior and population was gathered from seven marked natural populations, from random collections over the state, and from observations on laboratory populations.

The four species showed little or no behavioral thermoregulation. The thermo-activity range was broader in *Sternotherus* than in *Kinosternon*.

The rhythmic pattern of the diel cycle was influenced by temperature and light intensity.

The annual activity periods for *Sternotherus odoratus* and *Sternotherus carinatus carinatus* were estimated to be 330 days and 310 days respectively, in contrast to 265 days for *Kinosternon subrubrum hippocrepis* and 140 days for *Kinosternon flavescens flavescens*.

Turtles under 5 cm in carapace length fed on small aquatic insects, algae, and carrion. *Kinosternon* above 5 cm in carapace length ate larger food items such as clams, snails, and tadpoles. *Sternotherus* above 5 cm were predominantly molluscivorous.

Growth data obtained from recaptures, and from counts of the "annual rings" of the carapace or plastron showed some similarity in the growth rate for the four species, especially for individuals between 2.10 cm and 6.00 cm in carapace length. There was a comparable increase during the first six years, after which the growth rate steadily declined in *Sternotherus odoratus* and *Kinosternon subrubrum hippocrepis* while *Sternotherus carinatus carinatus* and *Kinosternon flavescens flavescens* continued at approximately the same rate. There was a great variation in the sizes of the turtles of each species relative to a certain age indicating possible individual differences in growth rate.

The four species showed limited movement. Individuals recaptured over long periods had moved only slightly farther than those recaptured over short periods. When a turtle was captured three or more times, its first-last-capture distance (FLCD) was compared to the maximum distance between successive captures. The majority of the first-last-capture distances were shorter than the maximum distances, suggesting that these turtles tend to return toward the point of their original capture and have limited activity range.

The breeding season for the four species extended from April to October. Eggs were found in the uteri of these species throughout this period. The size of egg clutch varied between 3 and 6.



The courtship performance was similar in the four species and involved smelling, nudging, mounting, followed by biting and rubbing.

Adult females outnumbered adult males and adults were more numerous than hatchlings at all times of the year. Population estimates for the four species were: 60.79 per acre for *Sternothaerus odoratus*, 92.60 per acre for *Sternothaerus carinatus carinatus*, 104.67 per acre for *Kinosternon subrubrum hippocrepis* and 11.37 per acre for *Kinosternon flavescens flavescens*.

Microfilm \$3.25; Xerox \$11.50. 252 pages.

SCARAB BEETLES OF THE GENUS  
*COPRIS* MUELLER OF THE WESTERN  
HEMISPHERE WITH NOTES ON  
BIOLOGY AND SEXUAL DIMORPHISM

(L. C. Card No. Mic 60-6496)

Eric Glasswell Matthews, Ph.D.  
Cornell University, 1960

The origin and affinities of the genus *Copris* Müller (Coleoptera, Scarabaeidae) are discussed and it is concluded from its present geographical distribution and fossil record that the genus arose in the early Cenozoic in the Old World as part of a stock of primitive dung beetles. The American representatives are of Asian origin and are believed to have invaded North America via the Bering Bridge in the Pliocene in the form of only two ancestral species, each of which gave rise to a species group. The center of speciation in the North American continent was the Mexican highland plateau and the Western Sierra Madre. The present distribution of the genus in the Western Hemisphere does not extend south of Ecuador.

Twenty-four American species and four subspecies are described; of these, two species and three subspecies are described as new. Two names (*procidius* Say and *clavicornis* Matthews and Halffter) are synonymized.

An analysis is presented of sexual dimorphism in the species with particular attention being paid to the allometric relationships of the male cephalic horn to the hind femur. It is shown that significant differences may be found in the allometry of the horn between species and even subspecies, involving changes in the position, but not the slope, of the relationship curve. Whereas horn length is strongly allometric within a species, between species it tends to be almost isometric if average values are considered. It is concluded that the horns are of definite selective advantage to the species, but their actual use is not known. They are definitely not used as species recognition characters.

Notes on the nidification behavior of six American species are presented. The biology of *Copris fricator* (F.) [= *tullius* (Oliv.)] is discussed in some detail, as is that of the European *C. hispanus* (L.) to provide background information. Original biological data are presented on four species.

Microfilm \$3.75; Xerox \$13.05. 290 pages.

NATURAL HISTORY AND IMMATURE  
STAGES OF CERTAIN SPECIES OF  
*SEPEDON*, *HOPLODICTYA*, AND  
*PROTODICTYA* (DIPTERA: SCIOMYZIDAE).

(L. C. Card No. Mic 60-6491)

Stuart Edmund Neff, Ph.D.  
Cornell University, 1960

Although adults of the Sciomyzidae are often found in considerable numbers in marshy areas, the immature stages and natural history of the family has remained obscure. Fourteen species included in the genus *Sepedon* were reared in the laboratory. They were as follows: *S. anchista*, *S. armipes*, *S. borealis*, *S. caerulea*, *S. fuscipennis*, *S. guatemalana*, *S. macropus*, *S. neili*, *S. praemiosa*, *S. pusilla*, *S. sphegea*, *S. spinipes americana*, *S. spinipes spinipes*, *S. tenuicornis* and *S. n. sp.* Larvae of these species kill and feed upon a wide variety of snails. Adults of all species except *S. tenuicornis* were taken in open, unshaded marshes. *S. tenuicornis* was encountered only in shaded swamps.

Two species in the genus *Hoplodictya*, *H. setosa* and *H. spinicornis*, were reared and studied. Larvae of both species attack and feed upon snails, but appear to be more restricted than *Sepedon* larvae in the species of snails eaten. Adults of *H. spinicornis* were collected in open marshlands and wet meadows; *H. setosa* adults appear to be confined to salt marsh areas along the Eastern Seaboard of the U. S.

The genus *Protodictya* is primarily Neotropical in distribution. One of the six known species, *P. hondurana*, was reared. Larvae kill and feed upon snails but remain in the empty shell after consuming the snails' flesh. Adults of this species were captured in wet, open meadows in Guatemala and Honduras.

All members of *Sepedon* studied except *S. borealis*, *S. neili*, and *S. pusilla* apparently breed continuously and without recognizable generations during favorable periods. *S. borealis*, *S. neili*, and *S. pusilla* appear to produce two generations per year. In temperate climates, known species of *Sepedon* apparently overwinter as adults. Little evidence has been obtained on the seasonal aspects of *Hoplodictya* spp. and *Protodictya hondurana*.

Laboratory-reared adults varied considerably in pre-oviposition period, egg laying, and longevity. Evidence indicated that adult diet affects the number of eggs produced. There was little apparent difference between egg hatching time, duration of larval stadia, and pupation time of any *Sepedon* spp. Some differences were observed between these characteristics in *Sepedon* and those in *Hoplodictya* and *Protodictya*.

All larvae examined possess a characteristic, unpaired sclerite ventral to the cephalopharyngeal skeleton mouthhooks. This sclerite, the ventral arch, bears small teeth on its anterior border and its shape appears to be a significant recognition character for the various genera included in the family. Possession of the ventral arch, lack of other accessory sclerites associated with the mouthhooks, and lack of general rami on the ventral surface of the pseudocephalic segment distinguishes the larvae of the Sciomyzidae from other known dipterous larvae.

The snail-feeding habits of the Sciomyzidae apparently have been derived from restricted saprophagous feeding. Modifications of these habits have given rise to the overt

predators that appear to characterize the larvae of the Tetanocerinae, the subfamily to which the three genera discussed belong.

Microfilm \$2.70; Xerox \$9.45. 206 pages.

STUDIES ON SOME DIGENETIC  
TREMATODES OF FISHES WITH REFERENCE  
TO THE ALLOCREADIOID PROBLEM

(L. C. Card No. Mic 60-6125)

Lewis Ernest Peters, Jr., Ph.D.  
Purdue University, 1960

Major Professor: Raymond M. Cable

In revising the taxonomy of the digenetic trematodes, La Rue recognized the problem posed by the families which he assigned to the Superfamily Allocreadioidea, with their diverse larval stages and, to a less striking degree, adult morphology as well. The present study attacks that problem from several directions, including the resolution of contradictions posed by the reported life histories in the genus *Allocreadium*, reconsideration of certain generic and family concepts, comparative morphology of miracidia, and the embryology of the excretory system, which has never been described in the Lepocreadiidae and the Acanthocolpidae.

The cercaria previously described for *Allocreadium ictaluri* cannot be the larva of that species because stylets with alae were found in metacercarial cysts from naturally infected clams. Instead, that cercaria probably is the larva of *Skriabinopsolus manteri*, a sturgeon parasite. It encysts in annelids and is compatible with the adult in morphology. Furthermore, the ecology of all stages is such as to indicate that the life history of *S. manteri* parallels that of the closely related *Deropristis inflata*. The embryology of the excretory system of that cercaria supports Skriabin's recognition of the Family Deropristidae, which is redefined to include two subfamilies, the Deropristiinae and the Cestrahelminae.

A marine trichocercous cercaria of the Lepocreadiidae, probably the larva of *Lepocreadium setiferoides*, agrees with the Allocreadioidea in the development of the excretory system, as does also *Cercaria pomatiopsidis*, a freshwater ophthalmocephaliocercaria developing in a gastropod. However, such is not the case in the Acanthocolpidae. In cercariae of that family, the primary excretory pores are well removed from the body-tail furrow and although conspicuous cells are associated with the formation of the bladder, it is doubtful that they form a persistent epithelium. The Family Acanthocolpidae accordingly is excluded from the Allocreadioidea and does not fit into any existing superfamily of La Rue's scheme. Its closest affinities seem to be with the Echinostomatoidea or perhaps the Opisthorchioidea, depending on the interpretation of cells associated with the excretory vesicle.

The genus *Dihemistephanus* is redefined and transferred from the Acanthocolpidae to the Subfamily Lepocreadiinae, Family Lepocreadiidae, on the basis of the type species, *D. lydiae*, which is redescribed.

A review of the known epidermal cell patterns for

digenetic trematodes indicates a predominant or even constant pattern for the family and sometimes for the superfamily. In the Allocreadioidea, the miracidium has four tiers of epidermal cells in a constant pattern of 6, 6, 4, 2, except in *Allocreadium ictaluri* with 6, 7, 4, 2. The gorgoderids seem to be unique in having three tiers of cells that are usually 6, 6, 3 in arrangement. Their miracidia further differ from those of allocreadiids in the number and arrangement of apical gland pores. Miracidial structure thus lends no support to the inclusion of the Gorgoderidae in the Allocreadiidae but features that those families have in common may be of greater taxonomic significance.

Microfilm \$2.50; Xerox \$4.80. 95 pages.

THYROID HORMONE CONTROL OF THE  
DEVELOPMENT OF THE CELLS OF  
THE LATERAL MOTOR COLUMN OF THE  
LUMBO-SACRAL CORD IN *RANA PIPIENS*

(L. C. Card No. Mic 60-5695)

James Race, Jr., Ph.D.  
State University of Iowa, 1960

Chairman: Professor Jerry J. Kollros

Beaudoin (Anat. Rec., 1955) reported that from the time of their first appearance (in limb bud stage III), the cells of the lateral motor column show slow growth and increase in differentiation. Just after the mid-larval period, when the hind limbs have been stimulated by thyroid hormone secretion to their most rapid rate of growth, there is a precipitous loss of over one half of the motor cells, accompanied by an increase in size of the surviving cells. Following limb ablation, the reduction in cell number and increase in cell size were delayed for several stages. The purpose of this study, using hypophysectomized larvae, is two-fold: (1) to determine to what extent thyroid hormone plays a role in the development of the cells of the lateral motor column in the lumbo-sacral cord; and (2) to determine the effect of limb loss upon this development.

The right hind limb of all animals was extirpated at stages II to VI. Any subsequent regenerates were removed. One group served as controls with animals fixed at 20, 60, 100 and 150 days. Another group served as experimentals, with animals immersed in solutions of 0.5, 10.0, 20.0, and 50.0  $\mu$ g d, l thyroxine/l, and fixed at stages IX, XI, XIII, and XVI. Cell counts of the lateral motor column were made on both the control and the operated sides in all animals. Nuclear measurements were made of at least 50 cells on each side of the cord.

In control animals, no development occurred past stage VI+, although kept as long as 217 days, and the large number of small-size motor cells were retained. Cells of the lateral motor column at 150 days were unchanged from those at 20 days. Even though cell counts on the operated side were slightly higher than those on the control side, they were within the normal range of counts for stages V to VII. Solutions of 0.5 to 20  $\mu$ g thyroxine/l duplicate the reduction in cell number seen in the cord of the normal animal. In the absence of a limb, cell loss is less



accelerated in response to the hormone than in the presence of a limb. There are significantly more cells on the operated side of the cord than on the control side at all stages. In solutions of 10 and 20  $\mu\text{g}$  thyroxine/l, there is clearly a precocious reduction in cell number. This can be attributed to the thyroid hormone. In solutions of 50  $\mu\text{g}$  thyroxine/l, the lateral motor column shows an initial hypoplasia, through degeneration. Many pycnotic nuclei and much cellular debris can be seen in the cord on the operated side.

The lateral motor column cells on the operated side lag behind the control side in their differentiation. They are significantly smaller than cells on the control side and look more like mantle nuclei than motor nuclei at all concentrations. Whereas the cells on the control side respond to increased thyroxine concentration (up to 10  $\mu\text{g}/\text{l}$ ) by a significant increase in nuclear size, those on the operated side remain unchanged. As with cell number, solutions of 20  $\mu\text{g}$  thyroxine/l produce a precocious increase in nuclear size on both sides of the cord, although the cells on the operated side are still significantly smaller than those on the control side.

It is evident that one role of thyroxine is to hasten the degeneration and transformation of the lateral motor column cells, presumably those which do not make functional peripheral connections. The role of the limb is not evident since the effect of limb loss can only be expressed following hormone treatment.

Microfilm \$2.50; Xerox \$3.00. 51 pages.

**SOME EFFECTS OF THE HORMONE  
PROLACTIN ON THE REPRODUCTIVE  
BEHAVIOR OF THE BROWN-HEADED  
COWBIRD (*MOLOTHRUS ATER*)**

(L. C. Card No. Mic 60-5608)

Gerald Garland Robinson, Ph.D.  
University of Minnesota, 1960

Most species of birds show some measure of normal nesting behavior including preparation of a nest, laying of eggs in the species' own nest, incubation of the eggs, feeding and brooding of the young. A few species have developed parasitic nesting habits and lay their eggs in the nests of other species. Most of North America has only one of the obligate parasitic species, the Brown-headed Cowbird (*Molothrus ater*). Although field studies of this species have produced fairly adequate descriptions of their habits, no studies have been carried out to determine the physiological basis of their aberrant behavior. Results obtained with other species indicated that the study of the effects of prolactin was the most promising starting point.

One male and one female Brown-headed Cowbird were placed in each of ten small cages for each of four experiments. Five pair were injected with prolactin and five pair were used as controls. The birds were exposed to nests and eggs in each experiment and the females were exposed to nestling birds in one experiment. The reactions of the prolactin-injected birds were compared with the reactions of the birds receiving only saline.

Four and one-half month old female cowbirds held under

12 hours of light per day responded to daily injections of 3.6 I.U. of prolactin with a greater than 10-fold increase in the amount of time spent in the incubation position. In later experiments 10-12 month old females in breeding condition either failed to respond or showed a small response to daily dosages as high as 20 I.U. of prolactin.

Male cowbirds four and one-half months old held under 12 hours of light per day responded to daily doses of 3.6 I.U. of prolactin with a marked drop in the number of song displays. Again 10-12 month old males in breeding condition showed a small response to 20 I.U. per day.

No indications of increased nest building or care of nestling birds were observed.

These results suggest that the lack of incubation in the Brown-headed Cowbird may be due, at least in part, to a decreased sensitivity to the hormone prolactin in the adult breeding birds.

Microfilm \$2.50; Xerox \$3.00. 40 pages.

**EFFECT OF THE SUBSTRATUM ON  
THE METAMORPHOSIS OF THE INTERTIDAL  
GASTROPODS *NASSARIUS OBSOLETUS*  
AND *NASSARIUS VIBEX***

(L. C. Card No. Mic 60-4867)

Rudolf Siegfried Scheltema, Ph.D.  
The University of North Carolina, 1960

Supervisor: Dr. Charles E. Jenner

Metamorphosis of the intertidal gastropod *Nassarius obsoletus* is markedly affected by the presence of a desirable substratum. If a habitat with a favorable bottom sediment is not encountered, metamorphosis can be delayed for more than two weeks. Bottom sediments favorable for inducing metamorphosis in the laboratory were found to correspond to those preferred under natural conditions. Biological attributes, rather than the physical character of the substratum, were the most important in inducing metamorphosis. When a favorable substratum was rendered abiotic by incineration, its metamorphosis-inducing property was removed. Altering the biological attributes of a favorable substratum lessened its effectiveness in inducing metamorphosis. The property of the substratum to induce metamorphosis could be transferred to the adjacent water; this conditioned sea water did not lose its metamorphosis-inducing property when passed through a molecular filter (0.8  $\mu\text{m}$ ). Perception of a biologically active substance by the veliger larvae apparently initiates a complex behavior pattern which includes further testing of the substratum and terminates in metamorphosis by the casting off of the velum *in toto*. A closely related species, *Nassarius vibex*, did not show a metamorphosis response to the presence of a natural substratum. Since *N. obsoletus* is a deposit feeder, the response to the substratum has considerable adaptive value, whereas to *N. vibex*, a scavenger, such a response presumably has little value. The ability to delay metamorphosis and to respond to a favorable substratum greatly enhances the probability that *N. obsoletus* will terminate its pelagic life in a favorable habitat.

Microfilm \$2.50; Xerox \$4.00. 71 pages.

VARIATION IN THE MIDDLE ATLANTIC  
COAST POPULATION OF THE GRAY  
SQUETEAGUE, *CYNOSCION REGALIS*  
(BLOCH AND SCHNEIDER) 1801.

(L. C. Card No. Mic 60-5373)

Rosemarie T. Seguin, Ph.D.  
University of Delaware, 1960

Supervisor: Franklin C. Daiber

Variation in certain morphometric and meristic characters of the gray squeteague, *Cynoscion regalis* (Bloch and Schneider), from six localities was investigated in an attempt to delimit and define the various geographic groups. The samples were composed of young-of-the-year fish, presumably spawned in the areas from which they were taken, collected during late summer and early fall in the years 1956, 1957, and 1958. The regions represented were: Gardiners Bay, New York; Delaware Bay; Chincoteague Bay; Upper Chesapeake Bay (above Potomac River); Lower Chesapeake Bay; and Pamlico and Albemarle Sounds.

The morphometric characters studied included standard length, head length, predorsal distance, prepelvic distance, body depth, and caudal peduncle depth. The meristic characters studied included vertebrae number, gill raker count, and dorsal spine and ray counts.

Morphometric characters were compared by covariance analyses using size on size relationships. Standard length was used as the independent variable and body part as the dependent variable. An extension of this method which uses the individual degrees of freedom is described. Comparisons of meristic characters were made by tests of independence. Statistical hypotheses were tested at the .01 level of significance. Among-years, within-region and among-regions, within-year, comparisons were made.

The results of these investigations indicate that three major geographical groups can be distinguished in young-of-the-year squeteague. These are (1) a northern group, New York, (2) a central group, Delaware, including possibly Lower Chesapeake, and (3) a southern group, North Carolina.

The Chincoteague group displayed heterogeneity in meristic characters from year to year, resembling the central group more closely in 1956, and the Upper Chesapeake group in 1957. In most morphometric characters it was more similar to the central segment.

The Upper Chesapeake group could not be assigned to any of the defined groups. The characters observed were generally intermediate in nature, suggesting some affinity with all three groups.

The characters found most useful in separation of these groups were head length, caudal peduncle depth, prepelvic distance, and gill raker number. Although differences were also observed in the other morphometric characters, the among-years, within-region variation raised some question as to their usefulness. The differences in dorsal spine and ray counts were not great enough to allow separation at the specified level of significance. The vertebrae number was relatively constant throughout the study area. Of 742 specimens examined only 7 deviants were observed, all of which appeared in the 1957 collections. No explanation can be made for this deviation on the basis of available environmental data.

Microfilm \$2.50; Xerox \$4.40. 84 pages.

A STUDY OF REASSOCIATION PHENOMENA  
AND HISTOGENETIC CAPACITIES OF  
DISSOCIATED CELLS FROM SELECTED  
TISSUES OF THE CHICKEN EMBRYO

(L. C. Card No. Mic 60-5253)

John E. Shannon, Jr., Ph.D.  
The University of Connecticut, 1960

The study deals with the problem of morphogenesis at the cell-tissue level and in particular with the following questions. 1. To what extent are dissociated cells capable of re-establishing the architecture typical of their tissue of origin? 2. What are some factors that influence this capacity? The specific objectives were: 1. To determine whether dissociated cells from embryonic chick tissues of the more advanced stages of development (nine to fifteen days) possess the same capacity to undergo characteristic histogenesis *in vitro* that has been demonstrated for the earlier embryonic chick rudiments (three to eight days) studied by Moscona and Moscona (1952), Weiss and James (1955), Trinkaus and Groves (1955), and Sobel (1958). 2. To study the reassociation phenomena and the histogenetic capacities of the cells under various experimental conditions *in vitro*. The dissociation technique employed was a modification of the trypsin dissociation procedure devised by Moscona (1952). The process of cell reaggregation was studied under various culture conditions using cells primarily from the liver. Cells from the metanephros were studied under similar conditions with respect to their capacity to form tubules.

It was found that: 1. The primary event in the reassociation of the cells upon return to calcium-containing media was the random agglutination of free-floating cells. Further aggregation was brought about by the active migration of cells or groups of cells. Smaller aggregates coalesced to form larger ones. By 48 hours the aggregates usually assumed a definitive spherical shape. Shortly after this the aggregates flattened out on the surface of the glass then the cells spread out to form a thin continuous sheet of cells. 2. Aggregate formation and the retention of three-dimensional form were markedly affected by different culture media. The largest aggregates and the longest persisting ones obtained by the usual methods of culture were formed in plasma-exudate medium. Next best was a special medium prepared by extracting minced embryos with horse serum. In standardly constituted tissue-culture media containing horse serum and in chemically defined media the aggregates rapidly dispersed and sheets of cells were formed. 3. Aggregate size, within limits, increased with an increase in inoculum size. Below a critical inoculum size three-dimensional aggregates were not formed and instead the cells spread over the surface of the glass. 4. Aggregate formation was partially inhibited by reduction of the calcium and magnesium content of the culture medium. Almost complete inhibition was obtained with the chelating agent, sodium versenate. 5. No evidence of histogenesis was obtained with metanephric cells under any conditions that lead to the early formation of thin sheets of cells. 6. The largest three-dimensional aggregations were formed when the cells were cultured on unperforated cellophane, on agar, in roller tubes, or in the presence of leg-mesenchyme cells. In all of these instances metanephric cells formed either rudimentary tubules or definitive tubules.



It is concluded that: 1. The divalent cations (calcium and possibly magnesium) are necessary for the "normal" reaggregation of embryonic chick cells in vitro and are probably just as important to cellular cohesiveness in vivo. 2. Reassociated cells from the metanephros of advanced developmental stages (nine to fifteen days) of the chick embryo possess a limited capacity to form tubular structures in vitro. 3. The extent of histogenesis that occurs in the masses of reassociated metanephric cells in vitro depends largely upon the manner in which the reassembly of the cells is affected by the culture conditions. 4. The cohesive and adhesive properties of cells are intimately involved in the above phenomena in vitro and also must be considered to be of fundamental importance to the formation and maintenance of supracellular structures in vivo. Microfilm \$2.50; Xerox \$6.00. 122 pages.

OBSERVATIONS ON HADROBREGMUS CARINATUS  
(SAY) AND OTHER WOOD-FEEDING ANOBIIDAE  
(COLEOPTERA) IN THE NORTHEASTERN  
UNITED STATES

(L. C. Card No. Mic 60-6455)

John Babbista Simeone, Ph.D.  
Cornell University, 1960

In a survey of the northeastern United States, the distribution and frequency of occurrence of several wood-feeding Anobiidae are determined. Among these, Hadrobregmus carinatus (Say) is found most frequently, followed by Ptilinus ruficornis Say. One of the species encountered is described as new and the name Ptilinus friendi n. sp. is proposed.

The species of host woods are given for H. carinatus and P. ruficornis. The former subsists upon hardwoods and softwoods, including Acer saccharinum L., Acer saccharum Marsh., Betula alleghaniensis Britton, Betula papyrifera Marsh., Fagus grandifolia Ehrh., Fraxinus americana L., Quercus alba L., Quercus rubra L., Tilia americana L., Picea spp., Pinus strobus L., Tsuga canadensis (L.) Carr. The latter limits its feeding to hardwoods, including Acer saccharinum L., Acer saccharum Marsh., Betula alleghaniensis Britton, Fagus grandifolia Ehrh., Tilia americana L.

The mean moisture content of infested wood in several cases is calculated to be 20.5 per cent for wood attacked by H. carinatus as compared to 16.9 per cent for wood attacked by P. ruficornis.

Emergence of H. carinatus and P. ruficornis adults, as studied over a three year period in a rural barn in central New York State, occurs initially the second or third week of June, reaches a peak the third week of June to the first week of July and subsides gradually until it terminates between the first and fourth weeks of July. Peak emergence of both species takes place approximately 12 days prior to that of Pelecotoma flavipes Melsh. (Coleoptera: Rhipiphoridae), a species which is believed to be of predaceous habit and is found in large numbers on the surfaces of wood attacked by Anobiidae. The sex ratio for H. carinatus and P. ruficornis is estimated to be 0.5. In the former species, males predominate on the surfaces of infested wood during daylight. However,

during the hour preceding and the two hours following darkness, when mating takes place and during the period of darkness, males and females appear on the wood surfaces in equal number.

Laboratory studies of egg incubation of H. carinatus under various conditions of temperature and relative humidity show the optimum relative humidity at 84°F. to be 85 per cent, the eggs having hatched in 12.05 days; at 71°F., 75 per cent, the eggs having hatched in 19.42 days; and at 59°F., 55 per cent, the eggs having hatched in 37.31 days. Expressed in terms of vapor pressure deficit, the optimum at all temperatures is approximately 4.5 millimeters of mercury. Thermal constants are shown to be in close agreement at each temperature and at optimum relative humidity: 446 at 84°F., 466 at 71°F., and 448 at 59°F. Attempts to learn similar temperature and humidity affects upon the larvae are largely unsuccessful. However, a few successful rearings indicate: (1) a one-year life history for both H. carinatus and P. ruficornis; (2) the necessity of a period of cold during immature development; and (3) the improved ability of the larvae of H. carinatus to enter test blocks of American beech Fagus grandifolia Ehrh. after the latter had been inoculated with the fungus Lenzites trabea (Pers.) F.

Among several Hymenoptera found with the Anobiidae, three Braconidae are believed to be parasitic: Bracon n. sp. upon P. ruficornis; and Heterospilus flavicollis (Ashm.) and Histeromerus canadensis Ashm. upon H. carinatus.

Twenty-four text figures, 12 text tables, and 33 appendix tables are included.

Microfilm \$2.50; Xerox \$8.60. 189 pages.

A STUDY OF CERTAIN PLANT AND  
ANIMAL INTERRELATIONS ON A NATIVE  
PRAIRIE IN NORTHWESTERN MINNESOTA

(L. C. Card No. Mic 60-5177)

John Robert Tester, Ph.D.  
University of Minnesota, 1960

Adviser: W. H. Marshall

A field study to determine the nature of the relationships between specific vegetative characteristics of the dominant grasses and litter found on a native prairie and changes in distribution and abundance of certain birds, mammals and insects was carried on at the Waubun Prairie Research Area in Mahnom County, Minnesota during the growing seasons of 1957, 1958 and 1959.

A total of 70 acres of relatively undisturbed native prairie was selected within the 640-acre tract. On five ten-acre plots treatments of mowing, grazing, or burning were carried out. Two plots were held as controls.

Detailed descriptions of these treatments; of the methods of vegetation analysis; of censusing populations of three species of birds, three species of small mammals, and two groups of insects; and the techniques of statistical analyses are given.

Striking changes in the per cent areal cover and depth of the litter occurred as the result of the treatments. The changes in per cent areal cover of big bluestem

(*Andropogon Gerardi*), little bluestem (*A. scoparius*), Indian grass (*Sorghastrum nutans*), and needlegrass (*Stipa spartea*) were small.

There were important changes in the distribution and abundance of breeding pairs of bobolinks (*Dolichonyx oryzivorus*), savannah sparrows (*Passerculus sandwichensis*), and LeConte's sparrows (*Passerherbulus caudatus*). On the basis of correlation analysis these changes appeared to be most closely associated with changes in litter.

In the case of the meadow vole (*Microtus pennsylvanicus*) changes in populations were associated in a positive manner with increasing litter. Those of the prairie deer mouse (*Peromyscus maniculatus bairdii*) were negatively associated with the same character of the vegetation. The masked shrew (*Sorex cinereus*) numbers seemed to be independent of the vegetative characteristics measured.

Analysis of the data for the two groups of insects indicated that grasshoppers (Orthoptera) were most abundant where light or moderate amounts of litter were found. High beetle (Coleoptera) populations appeared to be associated with sparse litter.

Some of the dynamic aspects of a climax prairie community are discussed on the basis of this study. The influence of land "use" on the organisms studied is demonstrated even though the climax status of the community did not appear to be actually altered by two or three years of treatment by mowing, burning, or grazing.

Microfilm \$2.50; Xerox \$4.60. 90 pages.

THE POST-WISCONSIN REDISTRIBUTION OF  
WHITE-FOOTED MICE, GENUS *PEROMYSCUS*  
GLOGER, IN NORTHEASTERN NORTH AMERICA,  
WITH PARTICULAR REFERENCE TO *PEROMYSCUS*  
*LEUCOPUS NOVEBORACENSIS* (FISCHER).

(L. C. Card No. Mic 60-5261)

Joseph Hemenway Waters, Ph.D.  
The University of Connecticut, 1960

This study was made to determine patterns of post-Wisconsin redistribution, and phylogenetic relationships, of traditional species and subspecies of the genus *Peromyscus* Gloger in eastern North America. The following subspecies of *P. leucopus* (Rafinesque) were studied: *noveboracensis* (Fischer), *leucopus* (Rafinesque), *ammodytes* Bangs, *fusus* Bangs, and *caudatus* R. W. Smith. Subspecies of *P. maniculatus* (Wagner) were also studied: *nubiterrae* Rhoads, *gracilis* (LeConte), *abietorum* Bangs, and *maniculatus* (Wagner).

Morphological studies, including statistical procedures, were made to determine the validity of traditional species and subspecies groupings, and to reveal any existing outstanding geographical relationships and trends in species and subspecies. Ecological studies were made to determine if individuals of *P. l. noveboracensis* with sharply bicolored tails have habitat preferences similar to those of *P. m. gracilis*. Breeding experiments were conducted to determine if *gracilis* and *noveboracensis* can hybridize successfully in the laboratory, and to reveal the genetic basis of weakly bicolored and sharply bicolored tails in

*noveboracensis*. Serological studies were made to determine the biochemical relationships of *P. m. abietorum*, *P. m. gracilis*, and *P. l. noveboracensis*.

Data from the morphological studies indicated *P. leucopus* and *P. maniculatus* to be valid species, and reinforced traditional subspecies groupings within *P. maniculatus*. *P. l. fusus*, *P. l. ammodytes*, and *P. l. caudatus* were demonstrated to be synonymous with *P. l. noveboracensis*, while *noveboracensis* from eastern Virginia and southeastern Pennsylvania were shown to be synonymous with *P. l. leucopus*. Morphological divergence within *P. leucopus* correlated with tail coloration was demonstrated. *P. m. abietorum* and *P. m. maniculatus* were shown to be morphologically intermediate to *P. m. gracilis* and subspecies of *P. leucopus*, and *P. m. nubiterrae* was shown to be farthest removed from *P. leucopus*. Morphological evidence was produced indicating recent hybridization in or near New England of *abietorum* and *maniculatus* with *noveboracensis* with sharply bicolored tails. Serological studies substantiated the intermediate relationship of *abietorum* to *gracilis* and *noveboracensis*. Breeding experiments failed to produce hybrids of *gracilis* with *noveboracensis*, but did indicate tail coloration in *noveboracensis* to be dependent on more than one set of autosomal genes. Ecological studies failed to produce pertinent information.

Results were correlated with fossil history and post-Wisconsin floral movements to derive a phylogenetic and redistributional scheme. Prior to retreat of the Wisconsin ice, *P. leucopus* and *P. maniculatus* were not distinct species. The latter occupied higher elevations in the southern third of the Appalachian chain, while the former was restricted to lower elevations south of the ice sheet. Coniferous forests moved north first behind the retreating ice sheet, and *P. maniculatus*, being associated with this forest complex, preceded *P. leucopus* northward. *P. m. nubiterrae*, perhaps closely related to the ancestral population, gave rise to *P. m. gracilis*, which in turn produced *P. m. abietorum* and *P. m. maniculatus* during the northward movement. *P. leucopus*, divided into two segments by the Appalachian chain, moved north with the secondarily advancing deciduous forests. The segment west of the Appalachians populated the mid-west and southwest. The eastern segment, primarily associated with the original Atlantic coastal plain, moved north to Canada and hybridized in or near New England with *P. m. abietorum*, and *P. m. maniculatus* to a lesser degree. This involved *P. l. noveboracensis* with sharply bicolored tails, indicating *noveboracensis* with weakly bicolored tails to be farther removed genetically from *P. maniculatus*. It is felt that species and subspecies are limited to their present ranges by morphological and physiological characteristics developed during the northward redistribution.

Microfilm \$2.50; Xerox \$5.60. 113 pages.



# SUPEROVULATION IN THE MOUSE AND RAT

(L. C. Card No. Mic 60-4224)

Everett Dale Wilson, Ph.D.  
Purdue University, 1960

Major Professor: Dr. M. X. Zarrow

The phenomenon of superovulation was studied in both the rat and mouse. A comparison was made of the response in these two species and the factors involved. The factors investigated were the effect of various doses of PMS, LH, and HCG on superovulation; the time interval between PMS--HCG injections and between the injection of HCG and autopsy; the age of the animal; the strain of animal; route of administration of the hormones; and specificity of the ovulating substance.

Superovulation was induced in intact immature mice of the Rockland-Swiss, Webster-Swiss, BAF<sub>1</sub>, BDF<sub>1</sub>, Balb/c, C<sub>3</sub>Heb, A/JAX, 129 strains, and Wistar rats with a single subcutaneous dose of pregnant mare's serum (Equinex) followed by a single subcutaneous dose of human chorionic gonadotropin (APL). The optimum time interval between the PMS and HCG injections was found to be from 30 to 50 hours in the mouse. In the rat, 56 hours has been reported to be the optimum time for PMS action. The optimum time interval between HCG injection and autopsy was 20 to 24 hours. Dose response curves were obtained for PMS, HCG, and LH in both the mouse and rat. The optimum dose of PMS for maximum ovulation in the mouse and rat was 30 IU and 10 IU respectively. High doses of PMS resulted in a decrease in egg count in both species. Cystic follicles were clearly evident in the rat and a pre-leutinization of the follicles occurred in the mouse.

A definite strain influence on ovulation was found in the mouse. The Rockland-Swiss ovulated an average of 44.4 ova, while under comparable conditions the 129 strain failed to ovulate.

The age of the immature rat or mouse was shown to be extremely important in obtaining maximum ovulation. An average peak response of 55.4 ova was obtained with 23-27 day old rats and 25 day old mice ovulated an average of 61.2 ova. Animals 30 to 60 days old ovulated approximately one half the maximum number.

Experiments were conducted to determine the influence of route of gonadotropic administration on superovulation. The subcutaneous route seems to give the most consistent results. In the Webster-Swiss mice an average of 39.6 ova was recovered following 5 IU HCG subcutaneously, whereas only 21.0 ova were counted following the same dose intraperitoneally. In the rat the route of HCG administration did not significantly alter the ova count.

HCG and LH were shown to be by far the best ovulating substances with average ova counts of as high as 75.5 following 400 IU HCG and 57.6 following 320 µg LH in the mouse. However, ovulation was induced to a limited degree in the rat with PMS and growth hormone. An average of 11.3 ova was obtained following 5 mg of growth hormone and 6.0 ova following a second dose of 20 IU PMS.

In summary it may be stated that relatively consistent results can be obtained if all the known factors which affect the superovulatory response in mice and rats are controlled. Microfilm \$2.50; Xerox \$6.60. 138 pages.

# THE BIOLOGY OF CERATOZETES CISALPINUS BERLESE, SCHELOBATES LAEVIGATUS KOCH, AND OPPIA NEERLANDICA OUDEMANS (ORIBATEI), WITH A DESCRIPTION OF ALL STAGES.

(L. C. Card No. Mic 60-5616)

Joseph Porter Woodring, Jr., Ph.D.  
University of Minnesota, 1960

Adviser: E. F. Cook

The general external morphology of higher oribatids is discussed and illustrated. All stages of *Ceratozetes cisalpinus*, *Schelobates laevigatus*, and *Oppia neerlandica* are described and illustrated. At 25°C., about 95% relative humidity, and with an optimum diet, *O. neerlandica* took 12 days, *C. cisalpinus* 24 days, and *S. laevigatus* 54 days to go from egg hatch to adult emergence. Under the above conditions over 95% of all eggs deposited resulted in reproducing adults. Growth and molting are described for each species. The formation and extent of the cerotegument in *C. cisalpinus* were investigated. Egg size is correlated with genital plate size, and *O. neerlandica* eggs were noted to be nearly twice as wide as the genital plate opening. Parthenogenesis was proven in *O. neerlandica*. Speeds afoot are tabulated for the three species, and what may be a primitive type of tactile communication was noted in *C. cisalpinus*. The microenvironment and habits of the immature stages of these species are described. The immature stages of *S. laevigatus* are burrowers, and can withstand dryer conditions than the surface dwelling *C. cisalpinus* and *O. neerlandica*. Spermatophore deposition and uptake was described in *C. cisalpinus*. Spermatophore deposition is directly correlated to the presence of females. The sperm in both the male and the spermatophores is killed by exposure to 35°C. It was found that after *C. cisalpinus* females had deposited their first batch of eggs, a second batch would not be produced unless the female was subjected to less than 5°C. for at least two and one half months. A population curve for *C. cisalpinus* is hypothesized on the basis of sperm inactivation by heat and adult egg deposition diapause, in addition to the usual predation and direct climatic factors. Water is postulated as the most important means of sod-inhabiting oribatid dispersal. Sod or sod products made a poor medium for the rearing of sod-inhabiting oribatids, and only *O. neerlandica* could be successfully cultured on it. *O. neerlandica* could be reared on mushroom, lichen, and fungal hyphae, but not on the artificial diet. *S. laevigatus* was most successfully reared on a combination of mushroom and lichen. The presence of *O. neerlandica* in cultures of *S. laevigatus* was essential in order to restrict fungal growth. *C. cisalpinus* could be reared on lichen, mushroom or artificial diet alone, or in any combination of these three foods. The artificial diet was the most successful single food for this species. By means of aseptic culturing, it was determined that newly hatched larvae of *C. cisalpinus* required growing fungal hyphae for initial feeding. Albinism occurred in *C. cisalpinus*, and its occurrence was partially correlated with overcrowded cultures.

Microfilm \$2.50; Xerox \$4.00. 75 pages.

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